NATURE

SATURDAY, JUNE 26, 1926.

CONTENTS.

	PAGE
Science, Industry and Education	881
Modern Views on the Origin of Birds. By Dr. H. Gadow, F.R.S.	883
More Relativity. By H. D.	885
A New Brunswick Geologist. By A. S.	886
Magnetism	887
Our Bookshelf	887
Letters to the Editor:	
Ether Drift Experiments.—Prof. Dayton C. Miller	890
Note on the Law of Radiation.—Sir Oliver J. Lodge, F.R.S.	891
Plastic Deformation of Single Metallic Crystals.—S. J. Wright	891
Dipole Moment and Molecular Structure.—Dr. Kristian Höjendahl	892
Efficient Use of Thermopiles.—A. Maurice Taylor	892
The Evolution of Beauty.—C. H. Henshaw	893
The Line Spectra of Isotopes.—Francis A. Jenkins	893
The Isotopes of Sulphur.—Dr. F. W. Aston, F.R.S.	893
Numerical Reduction of Instars in the Metamorphosis of Euphausids.—R. Macdonald	894
Abraham de Moivre.—Prof. R. C. Archibald	894
The Taxation of Research.—Prof. H. B. Baker, F.R.S., and Prof. Jocelyn Thorpe, F.R.S.	894
Frictional Forces in Liquid Surfaces.—L. H. G. Dines	894
The Light-Quantum Theory. By Dr. C. D. Ellis	895
The Origin of Petroleum. By Henry B. Milner	897
Obituary:—	
Sir William B. Leishman, K.C.M.G., C.B., F.R.S. By J. C. G. L.	899
Sir Frederick Mott, K.B.E., F.R.S.	900
Sir Henry Morris, Bart.	901
News and Views	902
Our Astronomical Column	906
Research Items	907
South-Eastern Union of Scientific Societies	909
Mechanism of Oxidation in Living Tissues	910
The Royal Society Conversazione	911
University and Educational Intelligence	912
Contemporary Birthdays	913
Societies and Academies	913
Official Publications Received	916
Diary of Societies and Conferences	916
Recent Scientific and Technical Books	Supp. v

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

NO. 2956, VOL. 117]

Science, Industry and Education.

THE relationship of science to industry is a subject that has been frequently discussed in these columns, and if we return to it once again it is because as time goes on we recognise more and more that industry without science is like a ship without a rudder, a thing that drifts hopelessly on the ocean of reality. Although we stand in the first place for culture—a knowledge of the best that has been thought and done in the world—we cannot overlook the fact, so abundantly proved by history, that nations of the highest culture become ready preys to the forces of barbarism and disorder when knowledge and attainments cease to maintain adequate connexion with the material realities of life, when capacity for action is "sicklied o'er with the pale cast of thought." Science has its idealistic side no less than religion, art, and morals, and its dominion should be coterminous with theirs in extending over the whole range of human activities: its content touches human life at a multitude of points, and its method is capable of almost universal application. Nevertheless, we have to realise that the battle of life is still fought mainly below the belt, and therefore we must look to science to play its part, not only in shifting the arena from the lower levels of brute force, cunning, and cupidity to the higher ground of truth, justice, and regard for posterity, but also in helping us to conquer in the fight as it is fought to-day.

Great Britain needs the help of science in a peculiar degree. Over-population, combined with neglect of agricultural possibilities, has forced us to rely for our material existence upon imported products, and these have to be paid for mainly by exporting manufactured goods. We have few, if any, closed markets, and success depends upon the high quality or novelty of our wares, and upon industrial organisation, all of which are dependent upon science. What progress are we making in promoting science and its application to industry and national life?

Apart from the valuable work which was done by the Government committee appointed to inquire into the teaching of science in our secondary schools, and that which is being done under the Department of Scientific and Industrial Research, we see few signs of progress. Disregarding exaggerated statements, we believe that the progress of science teaching in secondary schools has fallen below expectations, and that the methods pursued in our universities and technical colleges still leave something to be desired. From the point of view of science, the popular Press remains in the throes of barbarism, and literary men speak openly, if foolishly, of "the bankruptcy of science."

The chief cause of this unsatisfactory state of affairs is ignorance, and the chief remedy is organised, concerted action to popularise the teachings of science; to bring home to the layman what science has done for mankind in the past, the nature of the problems awaiting solution, and what science may do, if adequately supported, in the future.

Alone among scientific organisations, the British Science Guild and the British Association have done valuable work in disseminating scientific knowledge among the people, and their present efforts to establish a publicity service, similar to Science Service in the United States, are worthy of every encouragement and support. The collection, preparation and distribution of interesting and accurate notes and articles upon scientific subjects likely to be accepted by the public Press is, however, too great a burden for such voluntary organisations to bear unsupported, and, the question being one of national importance, it seems right that a Government which expends nearly 50,000,000*l.* annually on education —not reckoning the 30,000,000*l.* contributed from rates—should contribute towards the cost. In addition to a scientific news service, we need popular accounts of researches that have led to new knowledge, and more especially of those which have resulted in new developments or improvements in industry, transport, and public health.

The co-operation of the Department of Scientific and Industrial Research would be particularly desirable in this connexion. The publications of this Department are well known to and much appreciated by scientific workers; but they are not addressed to the layman or written in a style to attract him, and the more learned communications that occasionally see the light in the transactions of societies are even less suitable for the purpose. It is essential that the subject matter should be written up in an attractive style, as free as possible from technical terms, due regard being given to the human element. Experience having shown that, as a rule, the research workers and inventors are ill-fitted to describe their work in a manner understanded by the people, the writing should be done by those who have the gift of popular exposition, though the materials therefor should, when possible, be supplied, and the manuscripts revised, by the discoverers. An interesting development in this direction is the publication in the United States of Popular Research Narratives, collected by the Engineering Foundation of New York. The two volumes of "tales of discovery, invention, and research" that have been issued to date are excellently got up, and though many may think that they err on the side of brevity and 'scrappiness,' there is no doubt that the mode of presentation is good and that the writers and publishers will succeed in their attempt to interest the public.

It may be objected that, owing to the short period during which the Department of Scientific and Industrial Research has been in active existence, the results so far obtained are too meagre for the purpose we have in view; nevertheless, we believe that the twenty or so research associations, and national institutions like the Medical Research Council, the National Physical Laboratory, the Fuel Research Station, and Rothamsted, could provide between them an abundance of material; and if matter ran short, the wealth lying dormant in the records of learned societies, and in certain reports of Government Commissions, could easily be tapped. Another likely objection is that the publication of results of research in applied science would be against the interests of the manufacturers who subscribe to the research associations.

The answer to this contention is that it is nearly always possible to write a broad general account of a discovery or invention without disclosing important details of manufacture. Success in manufacture depends more often than not upon important details of plant or method of operating. True, but the public is not interested in such details; and, if necessary, the manufacturer can usually protect himself by letters patent. The manufacture of sulphuric acid by the contact process necessitated long years of work and a large expenditure of money before it was made a commercial success, yet the process was described at an early date in the columns of the *Berichte* with all the detail that even a scientific man desires; and similar statements could be made of many other processes, including those of Birkeland and Eyde, Franck and Caro, Haber, and Claude for the fixation of atmospheric nitrogen. In spite of assertions to the contrary made during the War, undue secrecy continues in our midst to the manifest disadvantage of the cause of science.

Another educational problem demanding attention is the training of science students who are destined for industry. In his Streatfeild memorial lecture (NATURE, December 12, 1925, p. 876), Mr. F. H. Carr, now president-elect of the Society of Chemical Industry, condemned the present training of chemical students for being too stereotyped: too much stress is laid upon training in research and too little on fostering ability to apply scientific knowledge to works' processes; there are many types of student-mind and many fields of possible application, yet we persist in casting all our material in the same mould. Prof. A. W. Crossley

expressed the same view in his recent presidential address to the Chemical Society, likening the teacher of chemistry to the manufacturer who persists in offering to foreign customers the goods he thinks they ought to want, rather than those for which they actually ask. The main types of chemist required in industry, Prof. Crossley points out, are the research worker, the equally important man who can apply new scientific data to industrial development, the chemist to control works' processes and undertake, or supervise, analytical work, and the chemical engineer. Each of these types requires in the first place a broad general training in, say, three sciences before specialisation is allowed, but thereafter the training must be adapted to the future career: the 'pure' chemist, the industrial chemist, the school or university teacher, each requires a different curriculum.

The blame for the present inadequate or misdirected training is not, however, entirely the teacher's; the manufacturer is also culpable in not making clear his wants, or making the fulfilment of those wants into practical possibilities. Last year, in commenting upon Prof. Wynne's address to the Chemical Society (NATURE, August 8, 1925, p. 195), we expressed the hope that manufacturers would devote attention to this matter, and we are now pleased to learn that, following the lead given by Sheffield, the British Dyestuffs Corporation has initiated a scheme whereby students may gain practical experience in its works during the long vacation. The result from the students' point of view, Prof. Crossley states, has been an unqualified success, and we do not doubt that the advantages will be mutual, for such vacation courses should afford the manufacturer excellent opportunity to select promising personnel for future employment.

We hope that this movement will spread, not only in the chemical industry, but also in the large and virgin field of applied physics. It is a happy omen that the demand in industry for trained physicists is considerably in excess of the supply. In the past, physicists as well as chemists have been trained too exclusively on academic lines, as if they were all to become teachers or 'pure' research workers. Important as these callings are, we are inclined to agree with the critics that an adequate supply of men whose special faculty lies in the application of scientific knowledge to industrial problems is at least of equal moment. Such men, it may be said, are born and not made; yet, if we believe in education at all, we must look to the universities and technical colleges to discover where this special ability is latent, and, knowing the needs of the manufacturer, to nurture it in the most fruitful way.

Modern Views on the Origin of Birds.

The Origin of Birds. By Gerhard Heilmann. Pp. vii + 208. (London: H. F. and G. Witherby, 1926.) 20*s*. net.

DIVERGENT views on much contested problems are often traceable to some rash statements, the authors of which were scarcely aware of there being involved some serious problem.

Numerous fossil three-toed footprints of obviously bipedal creatures were discovered about 1835 in the Triassic sandstone of Connecticut, and described by E. Hitchcock as Ornithichnites, bird-tracks. According to their size and configuration, which is all we know of their owners, various generic and specific names became assigned to them. Ch. L. Bonaparte (1856) combined these Ornithichnitidæ with the dodo, the subfossil Aepyornis, and the Eocene Gastornis as Inepti, a subgroup of his order Columbæ. A curious jumble of ineptness and sense.

Serious speculation about the origin of birds arose with the discovery (1860) of the famous Archæopteryx, from the upper Jurassic oolite of Solnhofen, near Eichstaedt, north-west of Ingolstadt, Bavaria. This specimen, now in the British Museum (Natural History), was first described by A. Wagner as Griphosaurus, "a reptile with bird's feathers." R. Owen monographed it (1863) as *Archæopteryx macroura*, "a bird with certain embryonic features." W. K. Parker (1867) published valuable remarks "On the relations of the Bird to the Reptile." Haeckel ("Generelle Morphologie," 1866) divided the birds into Sauriuræ (Archæopteryx) and Ornithuræ. T. Huxley, in his famous classification of birds (1867), retained the first name as Saururæ, but rightly discarded the Ornithuræ, dividing these with Merrem (1813) into Ratitæ and Carinatæ; and in his "Manual" (1871) he was the first to summarise clearly and concisely the descent of birds from reptiles, hence his term Sauropsida.

A second, much better preserved specimen, now in Berlin, was discovered (1877) also near Eichstaedt; first described and discussed by C. Vogt (1879) as "un intermédiaire entre les oiseaux et les reptiles." It has been exhaustively monographed by W. Dames (1884).

Heated discussions arose whether Archæopteryx was a direct forerunner of the Carinatæ, or merely a lonely offshoot, or last but by no means least, a true intermediate link or 'Schaltform' between reptiles and birds, a view which was disallowed by the Prussian Government. Dames added some further detail of the limb girdles in 1897; but both specimens remained otherwise undisturbed until, in 1917 and after, Petronievics persuaded the authorities to expose them. He distinguished the Berlin specimen as *Archæornis siemensi*.

Meanwhile (1875) zoologists had been startled by O. C. Marsh's discovery of birds with numerous teeth from the mid-Cretaceous of Kansas. They were sumptuously monographed as Odontornithes (1880), this new subclass to contain the large flightless aquatic Hesperornis, the well-flying Ichthyornis and Archæopteryx. Later consideration showed, however, that they were only a heterogeneous assembly, in fact that probably all birds had retained teeth unto the end of Cretaceous times.

Although Marsh himself emphasised the undoubted affinity of Hesperornis with the recent diver-grebe group, he also took the complete absence of a keel in the flat sternum as indicating close relationship to the Ratitæ. Dollo (1881) took up this idea and with merciless logic united Hesperornis with the Ratitæ proper, calling the former "une autruche carnivore aquatique," a nightmare which, thanks to a popular article by Wiedersheim, became a "schwimmender Strauss" and "swimming ostrich."

Dollo was probably instigated by P. Albrecht, an erratic genius who discovered the so-called fourth, or inner, distal, trochanter of Hesperornis, Iguanodon, and traceable in ducks, a coincidence which led him to say that iguanodon also was a swimmer. Thus it came to pass that the dinosaurs were roped in with the Ratitæ, and the Triassic ornithichnites were taken as welcome proof of the necessary great age of the whole assembly. This incredible muddle went so far that moas, cassowaries, kiwis, ostriches were, not in popular literature alone, looked upon as the direct survivors of some suitable dinosaurian side-branch, whilst the much later Archæopteryx was the progenitor of the modern flying birds.

The literature bearing upon the problematic origin of birds has assumed great dimensions. Within the last few years the most noteworthy serious contributions have been made by a Dane, a Swiss, and a Serbian. Their several publications overlap each other.

H. Steiner of Zürich (1917) settled the vexed question of the remiges ("Problem der Diataxie der Vogelextremität," *Jena Zeitschr.*). In 1922 followed a renewed study of the development of the wing-skeleton, a work not yet fully appreciated which will revolutionise our hitherto very faulty knowledge ("Ontogenetische und phylogenetische Entwicklung des Vogelflügelskelettes," *Acta zoologica*, Stockholm, 1922). By careful, well-illustrated comparison with recent and extinct reptiles, he concludes these birds form one great natural assembly with dinosaurs, crocodiles (including the ancestral Para- and Pseudosuchia), and the aberrant pterosaurs, all of which agree, unlike all other reptiles, by the preponderance of the sharp-clawed 1st to 3rd finger, while the 4th and 5th steadily tend to reduction; indicating undoubtedly arboreal, climbing adaptation. This view he justifies by good argumentation. It applies also to the presumable common ancestor. Crocodiles proper have, of course, taken to aquatic life in a tertiary way, while others, like dinosaurs, have descended or returned to the primary terrestrial, tetrapodal, and eventually bipedal life.

Comparison of dinosaurs with Ratitæ reveals no direct ancestral relationship. Therefore dinosaurs can be compared only with birds which did fly, and Archæopteryx, the sole available material, dates from a time when these reptiles were already too far pledged. Both classes produced the most surprising convergences, but these occur crosswise, mutually contradicting relationship; for example, this bird's foot agreeing most with that of some of the Saurischian division of the dinosaurs, whilst the bird's pelvis agrees most with that of the Ornithischian division, namely, iguanodonts.

Exaggeration of the still very imperfectly known differences between the London and Berlin Archæornithes and comparison with Struthio only, to the utter neglect of all the other modern Ratitæ, led Petronievics to the following surprising conclusions (B. Petronievics and A. S. Woodward, "Pectoral and pelvic arches . . . of Archæopteryx," *Proc. Zool. Soc.*, 1917; B. Petronievics, "Über die Berliner Archæornis, Genf. 1925" (Reprint of *Ann. Géolog. de la Péninsule Balcanique*, Belgrade, 1924)). The Archæornithes (the reviewer's term, 1893), still without a keel, diverged already in Jurassic times, so that (at the same place and time, in the lithographic slate) Archæopteryx as the Ur-Ratite founded the teethed Ratite Hesperornis and the toothless modern Ratites. —Archæornis produced the toothed Carinates, for example Ichthyornis, and all the toothless modern Carinates. This scheme he calls "a rational classification based upon strictly morphological characters, and further explanation unnecessary."

The common ancestor, the Protornis or Proavis, could fly, but had not yet a keel. Its immediate ancestors were the Protoherpornithes (the reviewer's Herpetornithes, 1893), which were covered with down only! This "eidechsenartiger Urvogel" arose from some primitive group of the Lacertilia. (He does not mention Steiner's work.)

Now, if there is anything proved by Fürbringer and others, "it is that what we call Ratitæ (namely, ostriches, cassowaries, kiwis, etc.) are the direct descendants of birds which have lost the power of flight; therefore also lost the keel, a reduction which is still happening to various Carinates, which even if losing all power of the keel could thereby never become Ratitæ, because these have retained other important ancestral characters no longer existing in modern

Carinates. The same complicated process has happened long before ostriches became flightless, a consideration which led Fürbringer in his elephantine work to invent the staggering terms of Proto-Deutero-Trito-Aptenornithes. Originally no feathered bipeds had a keel, but we must not be hypnotised by this deficiency lest we relapse into the belief in the "swimming ostrich" of fifty years ago.

G. Heilmann's carefully composed and extremely well illustrated book appeared first in Danish as "Fuglenes Afstemning," several instalments of which appeared in *Dansk Ornithol. For. Tidskr.* 1913–15, and an English version has now been prepared. More than half of the work contains the countless embryological and anatomical agreements of reptiles and birds and an exhaustive description of Archæopteryx; a good introduction for those who are not well acquainted with the subject. By reasoned elimination he restricts the possible ancestors of birds to the pterosaurs, predentate or ornithischian dinosaurs, cœlurosaurs, and pseudosuchia. The first group he disposes of easily.

The predentates, for example iguanodonts, present difficulties, but in spite of all resemblances these dinosaurs are found wanting. Perhaps by discarding their pelvis he protests too much, because the pelvis problem will not be solved without the hypothesis that it is fundamentally a polymetameric compound; further, the so-called pectineal process may be either entirely iliac or prepubic or both, according to the origin and extent of the ambiens muscle. The author feels convinced that this process of birds is iliac, therefore not the homologue of the reptilian prepubis. By thus ingeniously getting rid of the predentates he turns to the older group, the cœlurosaurs, which fascinate him by their cavernous vertebræ, a feature which he wrongly connects with the pneumatic skeleton of birds.

Concerning the forelimb the author closely agrees with Steiner (cf. Fig. 19), whom he does not mention. But even these creatures are not to be trusted, since their strong birdlike resemblances may be analogous adaptations. Thus he narrows the possible ancestry to the Pseudosuchia, which as probable ancestors of the theropodous dinosaurs and cœlurosaurs seem to possess in their still generalised condition all the necessary material and trend for future birds, as notably the structure of limbs, girdles, and skull. The final result is the origin of birds traced well into the Trias to the common ancestor of the archosaurian division of reptiles, in close agreement with Steiner.

For the impetus to flight Heilmann prefers with Abel and Steiner the arboricolous climbing life which encouraged jumping from branch to branch, and thus parachuting by patagia and enlarged feathers. Not Baron Nopcsa's dinosaur which gets the necessary momentum by running; nor does our author favour Beebe's 'Tetrapteryx,' although on p. 199 his own restoration of the Proavis shows no less than four or five feather parachutes. Those which forsook the trees and took to ground life specialised increasingly as runners.

The frontispiece, by the author, gives a charming picture of a loving couple of Archæornis, she of demure look and garb, he in full dress of brown, white, and—beautiful blue! H. GADOW.

More Relativity.

(1) *The A B C of Relativity.* By Bertrand Russell. Pp. v+231. (London: Kegan Paul and Co., Ltd.; New York: Harper and Bros., 1925.) 4*s.* 6*d.* net.

(2) *The Einstein Theory Explained and Analysed.* By Samuel H. Guggenheimer. Pp. ix + 326. (New York: The Macmillan Co., 1925.) 10*s.* 6*d.* net.

POPULAR accounts of the theory of relativity continue to appear, and one must presume from this that public interest in the subject has by no means died out. Writers at this time of day, however, are under an obligation which did not burden early expositors, in that they have to justify their intrusion into an already overcrowded field. However unsuccessful existing literature may have been in making the new ideas clear (the fact that interest in the subject is still maintained shows that a considerable measure of success must have been attained), the mere accumulation of volumes directed towards the same end is in itself an evil quite independent of the intrinsic worth of the volumes themselves. Too many cooks, though they be all masters of the gastronomic art, will nevertheless spoil the broth. Mr. Russell justifies his attempt on the ground that previous popular accounts of relativity "generally cease to be intelligible just at the point where they begin to say something important." Mr. Guggenheimer offers no apology, but breaks new ground by providing, not an account of the theory, but a critical examination of the manner of exposition which he finds in the English translation of Einstein's own popular book. It is extremely doubtful whether the motive is in either case a sufficient justification of the result.

(1) Mr. Russell, however, has written an extremely readable and lucid book, the substantial accuracy of which, of course, goes without saying. Perhaps its most characteristic and helpful feature is the excellence of the verbal illustrations which occur frequently and most of which are quite new. The chapters dealing with the relativity of time—the most difficult aspect of the subject to the beginner—are particularly clear, and the author is commendably precise in stating the possibilities of arranging events in a time order. The

widespread vague notion that, on the relativity theory, any event may be either before or after any other event, according to the time-system used, is effectively dispelled.

The choice of a title is not a happy one. It suggests the alphabet of the subject, which is of very little use to any one who does not intend to become a physicist. What Mr. Russell has actually presented is a much more valuable thing; namely, the *meaning* of relativity. He has rightly concentrated attention on the revolution in our concept of Nature which the theory brings about, and dealt effectively with the problem of separating, in our world of experience, the parts which belong respectively to external events and to the observer. The chief defect of the book seems to be the lack of any obvious connecting thread running through the whole. The reader who is able to follow each chapter quite clearly may be left at the end quite incapable of forming a definition of relativity suitable for a dictionary. As a particular example of this apparent disorder may be cited the discussion of 'force' in Chapter xiii. which harks back to a point already clearly raised and to some extent dealt with in Chapter viii. On the whole, however, Mr. Russell's book is certainly among the best popular accounts of relativity which have appeared.

(2) Mr. Guggenheimer's book, as has been said, is not an exposition of the theory at all, and its title is misleading. The author is confessedly neither a mathematician nor a physicist, and it is clear that he is not an astronomer. He approaches the subject from the metaphysical side, and subjects a number of passages of Einstein's elementary treatise to minute dissection. To the reviewer, who finds Mr. Guggenheimer's work far less intelligible than that of Einstein, he appears to introduce difficulties into Einstein's exposition and then to devote a considerable space to their elucidation. For example, several pages are occupied with a discussion of whether Einstein, in speaking of 'absolute' as contrasted with 'relative' motion, is "attempting to penetrate the noumenal world" and becoming involved in "an ultimate, absolute, and infinite First Cause."

The book may appeal to those who delight in mental gymnastics and are indifferent to the meaning of scientific relativity, but those who wish to understand Einstein's theory should carefully avoid it. The citation, with examples, of two defects will suffice to reveal its danger—the scientific statements are vague, and they are often inaccurate. As examples of vagueness we give two typical sentences: "All matter consists, in the last analysis, of one substance or energy in different conditions of electric charge or force" (p. 38). "Although body A may be at rest relative to body B, from which A appears to be moving, to an observer on B it will be A which appears to move, and neither is actually moving" (p. 167). Examples of inaccuracy are abundant in the very biassed discussion of the tests of the relativity theory. Thus, the existence of an intra-Mercurial planet is said to be "highly probable," and the deflexion of light by a body is said to increase with its radius, because a large radius "gives the force a longer time to exercise its accelerating pull upon the fast passing light." The author appears to have some power of thought and expression, which should be concentrated on a subject with which he is better acquainted. H. D.

A New Brunswick Geologist.

Loring Woart Bailey: the Story of a Man of Science. By Joseph Whitman Bailey. Pp. 141+12 plates. (St. John, New Brunswick: J. and A. McMillan, Ltd., 1925.) n.p.

IN this volume we are presented with an interesting life-history of one of the earliest leaders of scientific thought and education in the Maritime Provinces of Canada. In his scientific work, Dr. Bailey was closely associated with Dr. G. F. Matthew and rendered notable service to Dawson, Logan, and Selwyn in the earliest researches on the geology of what was then an unknown region. But he will perhaps be best remembered as having been for nearly half a century an active member of the faculty of the University of New Brunswick and as one of the little group of men who nurtured the Natural History Society in its infancy.

One of Dr. Bailey's ancestors sailed from England in the good ship *Angel Gabriel*, built for Sir Walter Raleigh. The ship was wrecked near Bristol, Maine, in 1635, but John Bailey survived. His descendant, the subject of this biography, was born in 1839 at West Point and was educated in the United States, but when he was not yet twenty-two years of age accepted an offer of a professorship at the University of New Brunswick at Fredericton. The appointment was opposed on the ground of his alien birth and extreme youth, but Bailey survived to become one of the leading figures of the institution. Here he built Sunnyside in open fields extending to the banks of New Brunswick's great river, and extended hospitality to many old friends, amongst others to his old pupil, the late Sir George Parkin.

After the publication of the "Origin of Species" the more aggressive types of scientific men and theologians commenced an acrimonious discussion, which is still liable to blaze. Dr. Bailey had sufficient tact to remain in harmony with both sides and was consulted by laity and clergy alike on scientific questions. In 1907, after forty-seven years' service, he retired, held

in the highest esteem by the students as well as by members of the faculty.

Dr. Bailey's scientific researches related to the Maritime Provinces. He was greatly interested in diatoms, but his more important work, done in association with Dr. Matthew, lay in collecting the fossils and determining the age of the geological formations of an unknown region. Within 15 miles of St. John he recognised representatives of formations ranging in age from Lower Laurentian to Trias. The work was commenced as a labour of love, but was continued from 1867 as a part of the programme of the Geological Survey. In 1913 Dr. Bailey acted as scientific guide to one of the excursions of the International Geological Congress. To one at least of that party his intimate knowledge of the geology of Albert, St. John and Victoria came as a revelation of what could be accomplished in unsympathetic surroundings. He died in 1925 in his eighty-sixth year. A. S.

Magnetism.

Modern Magnetics. By Prof. Felix Auerbach. Translated by H. C. Booth. Pp. vii+306. (London: Methuen and Co., Ltd., 1925.) 15*s.* net.

THIS work gives an admirable account of all the older work on magnetism. It does not assume much knowledge to start with, and without using much mathematics it takes the reader on to quite advanced subjects. The style is pleasant and easy—with perhaps a touch of the rather glutinous brightness of the German journalist. The book will be of value to many who already claim considerable knowledge of the subject.

The student who has worked out examination questions on magnetism has the impression that he understands all about magnetic force and magnetic induction, and that all that is necessary is to multiply together the mystical letters H and μ to get the still more mystical B. The present work will disabuse him of this impression and will replace it by a wholesome respect for the difficulties to be faced, both theoretical and practical. In this connexion it is really a pity that induction and permeability play so large a part in the mathematical text-books, for, in fact, magnetisation and susceptibility are not only more primitive ideas, but also are much more useful in the study of magnetism itself, especially in the case of ferromagnetism.

The volume claims to deal with the whole field of magnetism, and it is disappointing to find that a work published in 1925 makes no mention of an experiment of such fundamental importance as the Stern Gerlach experiment, which directly exhibits the magnetic moments of atoms. The German original came out in 1921, which would explain this omission, but it would not justify the absence of any account of the almost equally important gyromagnetic effects and of, at any rate, the earlier of the recent developments of the theory of the Zeeman effect. Indeed, it is a little surprising to find the name "Modern Magnetics" applied to a book containing a bibliography—and a very full one—with no reference to work later than five years before its publication in German, and nearly ten years before the translation.

It is a great pity that a supplementary chapter or two has not been added so as to bring the account a little more closely up-to-date. Still, this is perhaps a tribute rather to the rate at which the subject has developed than a criticism of the content of the book—which may be very strongly recommended to any one wishing to acquire a knowledge of the more classical parts of the theory of magnetism.

Our Bookshelf.

Contemporary British Philosophy: Personal Statements. (Second Series.) By James Ward, E. Belfort Bax, Douglas Fawcett, G. Dawes Hicks, R. F. Alfred Hoernlé, C. E. M. Joad, G. E. Moore, J. A. Smith, W. R. Sorley, A. E. Taylor, J. Arthur Thomson, Clement C. J. Webb. Edited by Dr. J. H. Muirhead. (Library of Philosophy.) Pp. 365. (London: George Allen and Unwin, Ltd.; New York: The Macmillan Co., 1925.) 16*s.* net.

THE twelve contributions contained in this volume cover a very wide field and are naturally unequal in value. Some writers attempt a sketch of a complete philosophy, while others deal with special problems. The first place is given as a "tribute of respect" to the article by the late Prof. James Ward, which, as the editor tells us, may be looked upon as Prof. Ward's "last will and testament to his contemporaries on the subject of general philosophy." The function of the latter he takes to be to understand experience as a whole, "to find a unity and meaning in the entire sum of things, beyond the so-called system of nature as science conceives it." His general position is well indicated in the title of his article, "A Theistic Monadism." It owes much to Kant and Lotze, and especially to a lifelong study, of great penetration and insight, of the natural sciences; though, as he points out, he has often been, strangely enough, accused of 'attacking' and 'reviling' them.

The view of philosophy as synoptic is also taken by other contributors, notably by Prof. R. F. A. Hoernlé and by Prof. J. Arthur Thomson. On the other hand, Prof. A. E. Taylor takes a more modest view of the nature of metaphysical speculation, the object of which, according to him, is not the unification of the sciences, but "the necessarily imperfect and tentative reconciliation of the exigences of scientific thinking with the imperative moral and religious demands of life." He devotes his article to a study of "The Freedom of Man," and gives a spirited defence of indeterminism and real contingency as involved in the moral life of man. Stress is also laid on moral values by Prof. W. R. Sorley, who seeks to bring out the bearing of

the objectivity of value upon central metaphysical problems.

On the side of epistemology the most noteworthy articles are those of Prof. G. E. Moore on "A Defence of Common Sense" and of Prof. G. Dawes Hicks entitled "From Idealism to Realism." The latter gives a lucid account of the main principles of a realistic theory of knowledge at which he has been working for many years. His central position is that cognition is of one character through all its forms, and consists essentially in an act of judging, and that the primary function of discriminating, comparing and relating is present from the very beginning of cognitive apprehension.

In an interesting preface the editor points out the chief directions in which, despite apparent conflict and opposition, contemporary thinkers tend to approximate to one another and to arrive at common results.

M. G.

Industrial Electricity. By Prof. Chester L. Dawes. (Electrical Engineering Texts.) Part 2. Pp. xv+480. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1925.) 13*s.* 9*d.* net.

THE great progress that has been made in recent years by electrical engineers in the application of theory to their craft is well illustrated by this volume. When alternating currents are employed the use of polyphase systems is almost universal, the principal exception being a few single-phase railways. One advantage of the polyphase system is the steady torque produced on the generators and motors, it being analogous to a multicylinder petrol engine. In the chapter on transmission and distribution we were interested to find that the author sometimes uses 'earth' and sometimes 'ground.' The former word is everywhere used in Great Britain and the latter is practically always used in the United States. The importance of keeping down earth currents in tramway systems is pointed out. The first method given is to use good bonds between the rails, and the second is to induce the gas and water companies to insert occasional insulating joints in their pipes. We are told that in some American cities the voltage drop along the rails must not exceed 15 volts. In Great Britain the maximum permissible drop is 7 volts, but series dynamos (negative boosters) are generally used to keep down the pressures at various points of the track. The chapter on photometry is good. We are glad that the author does not strive to use different symbols for all the various quantities he discusses. He uses *I* both for current and candle-power.

The chapter on electron tubes (vacuum tubes or thermionic valves) will be very helpful to the older engineers, excellent descriptions being given of the three electrode valve, regeneration, power valves, carrier waves, and broadcasting apparatus. Modern methods of wiring buildings for the electric light are next described. Supply pressures of 300 volts are mentioned. In England 240 volts is the maximum, and in Europe much lower pressures are often used. A useful collection of 260 problems is added, telephone relays and loud speakers replacing the carbon lamps and tangent galvanometers of an earlier generation.

Transformers for Single and Multiphase Currents: a Treatise on their Theory, Construction and Use. By Prof. Gisbert Kapp. Third edition, revised by Reginald O. Kapp. Pp. xi+391+11 plates. (London: Sir Isaac Pitman and Sons, Ltd., 1925.) 15*s.* net.

THE late Prof. Kapp prepared the second edition of this book in 1908. He pointed out that "during the last twelve years enormous improvements have taken place in the construction of transformers." He also said that transformers so large as 1000 kilowatts have been constructed. His son in this edition says that single transformers up to 60,000 kilowatts, or better 60,000 kilovolt-amperes, are in service and testing transformers have been built which give a million volts. The tendency towards the centralisation of power supply during the last eighteen years has become very marked and the electric output has vastly increased. Remembering that most of the electrical energy generated passes through two transformers at least, the capacity of the transformers installed in Great Britain at present must be very great. The trend of development during recent years has been to pay far greater attention to the problems of economical manufacture and mechanical construction and to improving the insulating materials employed.

The book is intended for electrical engineering students and for the engineers of supply stations. More space is devoted in this volume to points of construction, installation and maintenance. Much of the matter dealing with the general theory of electrical engineering has been omitted, and also descriptions of devices which are now obsolete. Examples of the latest types of transformers by well-known makers are fully described. The book will be found helpful by practical engineers.

Manual of Injurious Insects. By Prof. Glenn W. Herrick. Pp. xxi+489. (New York: Henry Holt and Co., 1925.) 4.50 dollars.

THE author of this book, who is professor of economic entomology at Cornell University, remarks in his introduction: "It is hoped that the book may be useful to the teacher and to the student of economic entomology; and that it may serve as a reference book to any one interested in the activities, injuries and control of the more common injurious insects of the United States." It should fulfil all these hopes to a greater or lesser degree, since it is accurate, clearly and concisely written, well illustrated, and has sufficient references to guide its readers to sources of fuller information. The various pests are dealt with under the plants which they affect, while there are also chapters on pests of live-stock and of the household, but forest insects are, for some reason, omitted.

The book presents certain features not usually found in works of this character. First, there is a pleasing absence of most of the time-honoured illustrations that have done duty in almost every book on the subject for the last twenty years; more recent and often original figures have been utilised. Secondly, there are more than 100 small maps showing the distribution in the United States of each of the major pests for which trustworthy data are available. Thirdly, there is some account (although brief) of the control of pests by biological methods. The book will doubt-

lessly prove of service in Canada as well as in the United States, and, it may be added, a considerable number of references to the literature of Canadian economic entomology are included. A. D. I.

Phototopography: a Practical Manual of Photographic Surveying Methods. By Arthur Lovat Higgins. Pp. xv + 130 + 9 plates. (Cambridge: At the University Press, 1926.) 6*s*.

THIS book describes, clearly and concisely, the theory and practice of ground photo-surveying. Surveys carried out by this method suffer from two serious disadvantages. There will always be some 'dead ground' which has not been surveyed, and plotting a map from photographs is such a long and complicated process that the time gained in the field is usually lost in the office. The plotting and drawing are much simplified by the use of a stereoplanigraph, but this machine is very expensive, and few survey establishments can afford to purchase it.

Ground photographs have been used for the surveys of mountainous areas in Canada, but the method has not hitherto been employed in other parts of the British Empire. A photographic survey of Kashmir will be carried out by the Survey of India this year, and the most modern instruments and methods will be thoroughly tested. Future developments will depend upon the experience gained in Kashmir. Meanwhile, this book can be recommended to all who are interested in the subject. The stereoplanigraph is not described in detail. For this a separate volume would have been required, for the instrument is as complicated as it is expensive.

It is to be hoped that as the methods develop some simplification of the technical terms may be found possible, and that words such as 'stereophototopography' may be allowed to die a natural death.

Psyche: the Cult of Souls and Belief in Immortality among the Greeks. By Erwin Rohde. Translated from the eighth edition by W. B. Hillis. (International Library of Psychology, Philosophy and Scientific Method.) Pp. xvi + 626. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., Ltd., 1925.) 25*s*. net.

ROHDE'S "Psyche" marked a turning-point in the study of comparative religion when it first appeared in 1893; it has become a classic, and has been through eight German editions without change since the premature death of the author in the interval between the second and the third. Now it appears in a carefully translated English version, with the notes transferred to the end of each chapter, and the appendices to the end of the volume; a practice deplored by Rohde himself, but a great improvement in a book which appeals quite as much to the 'general reader' as to the specialist.

The translator has done another considerable service in revising the whole of the references to ancient authors, whom Rohde used to cite from the edition nearest his hand as he wrote. Only one other thing he might have done with advantage, namely, to record the pagination of the first German edition, by which Rohde's earlier critics quoted him. How convenient this is, in a book of this sort, those who have used the later German editions know. Rohde's chapters are long, and not divided into sections. But the main thing is to have an English version of Rohde's work at all, and it should be widely appreciated.

Lehrbuch der Pflanzenphysiologie. Von Prof. Dr. S. Kostytschew. Erster Band: *Chemische Physiologie.* Pp. vii + 567. (Berlin: Julius Springer, 1926.) 27 gold marks.

THIS first volume of a new plant physiology, hailing from Leningrad, is of quite exceptional interest. The citation of literature is exceedingly full and complete, and in many cases the references to Russian literature deal with work which is very little known in Great Britain. Thus Russian work upon the colourless chromogen, leucophyll, said to precede chlorophyll during development in the dark, and Russian work upon the nutrition of flowering plants when grown under sterile soil conditions, is somewhat fully referred to. This first volume, recognising that the modern botanist requires a critical chemical equipment, deals with the processes of metabolism from a chemical point of view and commences with an introductory chapter upon the fundamental chemical questions involved in interpretations of plant physiology.

In the second volume, problems of the entrance and translocation of solvents and solutes are to be dealt with, together with problems of growth and plant movements, and also tissue differentiation and correlations.

The Physiology of Plants: the Principles of Food Production. By Prof. G. J. Peirce. Pp. x + 363. (New York: Henry Holt and Co., 1926.) 3 dollars.

THIS is a somewhat discursive treatment of some of the main problems of plant physiology, particularly nutrition, water movement, respiration, and irritability. These problems are handled more fully than they would be in an elementary text; on the other hand, neither the necessary physics and chemistry, nor the essential physiological considerations, can be said to be handled thoroughly, whilst there is considerable repetition arising from the discursive nature of the book. Many readers may find the author's viewpoint interesting, however, even when he is traversing familiar ground. Thus the human and industrial contacts of plant physiology are often emphasised, and a considerable amount of recent work is discussed from an individual and, to some extent, a critical point of view.

Laundry Chemistry: a Short Handbook on the Chemistry of Laundry Materials and Methods. By A. Harvey. (Lockwood's Manuals.) Pp. viii + 116. (London: Crosby Lockwood and Son, 1926.) 4*s*. net.

THIS book contains brief accounts of those parts of chemistry which are involved in laundering processes, with a short introduction to elementary chemistry. Much of the information is otherwise obtainable only in large treatises or dictionaries, and it is undoubtedly useful and convenient to have it collected in a small manual of this kind. The information is accurate and up-to-date. The book is well printed, and should prove useful to students and those engaged in laundering. The author has evidently an excellent practical knowledge of the subject.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Ether Drift Experiments.

THE editor has kindly shown me the proof of a letter from Sir Oliver Lodge, relating to my ether drift experiments, and in particular to the account of this work recently given at the Royal Institution. Sir Oliver has in a very courteous manner described the principal argument put forth, and, as he says, the matter is now before the scientific world, *sub judice*. Notwithstanding this, it may not be out of order to make further explanation of some of the points raised by Sir Oliver.

It seems necessary to direct attention again to the fact that this experiment has never given a true zero or 'null' effect in general; it has only given a 'negative' result, that is, it has answered 'no' to a specific question. Following the report by Morley and Miller, in 1905, Prof. Einstein made the hypothesis that the motion of the observer produces no effect upon the apparent velocity of light. This hypothesis has been given in hundreds of books as the correct interpretation of the experiments, and has been accepted, perhaps without fully examining the original papers. Michelson and Morley, in 1887, said: "Considering the motion of the earth in its orbit only . . . the relative velocity of the earth and the ether is . . . certainly less than one-fourth of the orbital velocity. . . . In what precedes only the orbital motion of the earth is considered. If this is combined with the motion of the solar system, concerning which but little is known with certainty, the result would have to be modified." In 1905 Morley and Miller, using a much larger interferometer, included in the calculations with the orbital motion of the earth a presumed motion of the solar system of twenty kilometres per second towards the constellation Hercules (still leaving the orbital motion predominant), and came to practically the same conclusion. But, in each of these reports the effect to be expected was calculated in advance, both as to direction and magnitude, and then the observations at two different times of day (as determined from the expected result) were combined so as to add together the expected components, and so as to cancel effects other than those being looked for.

In all of these observations there was a definite positive result, which is observed as a periodic displacement of the interference fringes; but, for the two calculated times of day, the phases of the positive periods differed in such a way that when the two sets of readings were added, they neutralised each other and left only the very small result which was correctly reported as that obtained for the orbital component of any existing ether drift. It is this positive effect, then eliminated, that is now being examined. While it is not large, it is by no means insignificant; the present amount of observed relative motion is 10 kilometres per second with a probable error of $\pm 0{\cdot}5$ kilometres per second. As this effect was not 'expected' it was not easy to interpret. The history of the experiment has been given in *Science* for June 19, 1925, and in a more concise report in NATURE for July 11, 1925, p. 49. The re-examination of all of the observations from 1887 to 1926, is the subject of a paper presented to the National Academy of Sciences in Washington on April 26, 1926, and not yet published. It is hoped to give a summary of this paper shortly in NATURE.

Sir Oliver Lodge asks what would appear if the results were plotted on the hypothesis that the south side of the housing is warmer than the north side, or with regard to other conditions. It is exactly for answering these questions, and others, that the experiments have been continued over a period of six years, in which time the thousands of readings have been made. Every disturbing cause that could be thought of has been exhaustively studied; among these are: daily and annual variations in temperature, meteorological conditions, radiant heat, magnetism, magneto-striction, differential gravitation, gyrostatic action, influence of method of illumination, transparent and opaque coverings of the light path, speed and direction of rotation, lack of balance in the rotating parts, position of the observer, and other conditions. One after another, these disturbances have been shown *not* to produce the observed effects. Finally, it has been possible to combine into one logical solution *all* the readings made to test all these varying conditions, without any omissions (excepting a few readings made under abnormal conditions, such as artificial heating), without any corrections, and without assigning any weights. This solution is entirely consistent with the observations of Michelson and Morley of 1887, and with those of Morley and Miller of 1902–1906.

The observations with the interferometer are made to detect a periodic shift of the fringes, periodic in each half-turn of the instrument; it is not the absolute position of the fringes that is important, but rather the periodic, vibratory change in the position of the fringes, as the interferometer turns through 180°. This can be detected best by having the instrument in slow and uniform movement, while the observer watches the fringes continuously. The instrument turns once in about a minute, and floats so freely that when once started it will continue in rotation for more than two hours without being touched. A series of readings is made in less than fifteen minutes.

The important part of the argument is that the reported effect has always been present, and is evident in every single observation and not merely in the mean; it is not related to the instrument, or to its surroundings; neither is it dependent upon day and night, or summer and winter; it is clearly shown to be directly related to sidereal time, that is, to a cosmical cause. This is explained, with numerous curves showing the results of the 1925 observations, in *Science* for May 1, 1926. The final arguments are based upon four very complete series of observations made at Mount Wilson for the epochs April 1, August 1, and September 15, 1925, and for February 8, 1926, thus covering various seasonal conditions, and various orbital positions of the earth.

In making the observations, two independent quantities are noted, the direction in which the interferometer points when the effect is a maximum, and the amount of the periodic displacement of the interference fringes. Each of these two sets of readings leads to an independent determination of the right ascension and declination of the apex of the supposed motion of the earth in space. It is very significant that these two determinations are wholly concordant.

DAYTON C. MILLER.

Note on the Law of Radiation.

IN connexion with the distribution of black-body temperature-radiation among different wave-lengths, the law of that distribution suggested by the late Lord Rayleigh for long wave-lengths is now well known to require the interesting and important correction factor $\frac{x}{e^x - 1}$ (where x is $\frac{hc}{RT\lambda}$ or, as Dr. Jeans has virtually pointed out, very nearly $32\pi^3 \frac{\epsilon^2/K}{RT\lambda^4}$, the electronic charge being ϵ), in order to adapt it to all wave-lengths. This factor could not have been deduced from dynamical reasoning, even with the help of the electron and the laws of probability, without the postulate of a previously unsuspected discontinuity in the interaction between ether and matter. Not because the expression for x (which in itself is full of speculative interest) contains any discontinuity, but because the denominator of the correction-factor $(e^x - 1)$ suggests, as my brother has pointed out (NATURE, May 30, 1925), a continuous accumulation at compound interest with the periodic emission of a dividend. The steady growth of a tree through a summer, with occasional spasmodic drop of an apple to a lower energy level, may be in some respects a permissible analogy.

There seems some risk that in order to emphasise the novel character of this discovery of Max Planck's, supplemented as it was by Einstein, teachers of senior physics may convey the impression that Lord Rayleigh had enunciated his law as complete; whereas he was under no such mistaken impression. He knew that his law was a partial one, and could apply only to long waves. I had thought of quoting from his original 1900 Memoir on the subject, together with a footnote added in 1902, in support of this contention (see vol. 4 of Rayleigh's "Collected Papers," p. 485), since there seemed a risk of its being overlooked by readers of Dr. Jeans's admirable Report to the Physical Society on "Radiation and the Quantum Theory." But I have found that the true position is clearly admitted and stated by Dr. Jeans in his book on "The Dynamical Theory of Gases" (p. 359, third edition).

Rayleigh's law, I may remind readers, is that if E is the total radiated energy at the temperature T (which energy may be plotted as an area with a wave-length base) its distribution among different wave-lengths (or the ordinates of the continuous-spectrum energy curve) will be:

$$dE/d\lambda = 8\pi RT\lambda^{-4}.$$

Rayleigh threw out his suggestion as the simplest definite form of Wien's thermodynamically-derived and well-established so-called "displacement law" connecting energy at each wave-length with absolute temperature:

$$\lambda^{-5}\phi(\lambda T).$$

The new form represented a special case; and the replacement of λ^{-5} by $\lambda^{-4}T$ was convenient for several reasons: (1) Because it emphasised the fact that atomic energy in each mode must be proportional to T (which was disguised in Wien's form); (2) because it brought in the known gas constant instead of an unknown function; and (3) because it was in accordance with the Maxwell-Boltzmann law of equipartition.

Rayleigh expected that his expression might represent the true law of radiation when λT was great; and so it has turned out. The law is true so far as *matter* is concerned; that is, it is true if an atom radiated, as a sounding body does, into a material medium. That something more was required to bring in non-matter, like the ether, was clear, because for some unknown reason equipartition would not apply to that; even proportionality to temperature need not hold in the ether. No one could deduce the complete law without further discovery. Each step from matter to ether, or back again, demanded the quantum factor, and does demand it wherever such interaction occurs. The gradual Keplerian manner in which the true law was guessed was a triumph of genius. Bohr's subsequent pictorial representation of the quantum at work, in the structure and behaviour of a radiating atom, was another. In this connexion I find that an ancient address of Clerk Maxwell's to the Chemical Society in 1875 (which I had the privilege of hearing, and which is reported in NATURE, vol. 11, pp. 357, 374) contains the following now rather amusing anticipatory paragraph (see also p. 435, vol. 2, of Maxwell's "Collected Papers"):

"The theory of the possible vibrations of a molecule has not yet been studied as it ought, with the help of a continual comparison between the dynamical theory and the evidence of the spectroscope. An intelligent student, armed with the calculus and the spectroscope, can hardly fail to discover some important fact about the internal constitution of a molecule."

We are living in a period of remarkable discoveries, which rather tend to put in the shade some of the older physics. Nevertheless, as an intermediate stage, complete so far as matter is concerned, Lord Rayleigh's partial statement was most useful. It never pretended to be more complete than it was, and it is only fair to his well-known care and scrupulous caution to emphasise this. OLIVER J. LODGE.

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Plastic Deformation of Single Metallic Crystals.

IN a letter to NATURE (May 22, p. 720), Messrs. Millington and Thompson discussed the wedge-shaped fracture which ordinarily results from a tensile test on a single metallic crystal. On the assumption of uniform slip on a number of parallel planes they calculate the magnitude of an angle which they assume to be the angle of a wedge-shaped fracture produced by the slip. May I point out that uniform slip of the type they consider, on one or more sets of parallel planes, would result in uniform extension together with a uniform change in the cross-section over the whole of the portion of the specimen which is slipping, and consequently no wedge-shaped fracture could result? The angle which was calculated in the letter referred to is the inclination of the axis of the 'slipped' portion of the specimen to the axis of the portion which has not slipped, and this has no connexion whatever with the angle of a wedge fracture.

In the earlier stages of a tensile test on a single crystal the act of slipping on any plane increases the resistance of that plane to further slip. This has the effect of distributing the slip more or less evenly over all the planes of the same type so that uniform extension results. At some stage, however, this strengthening action appears to become exhausted and a zone of weakness is set up. The final wedge fracture results from non-uniform slip in this region, the extent of the slip on the set or sets of planes involved becoming progressively greater as the weakest point is approached from either side. No calculation of the angle of the final fracture can be made without some information as to the nature and extent of the zone of weakness referred to, and there appears to be

no evidence available on this point. However, it may, I think, be definitely stated that the occurrence of a wedge-shaped fracture is an indication that non-uniform slip has occurred in its neighbourhood. The only deduction that can safely be made from the shape and orientation of the wedge concerns the number of sets of parallel planes involved. In general slip occurs on two such sets, and the final line of cleavage will be parallel to their lines of intersection. The actual examination of a number of fractures of single crystals of aluminium encountered by the writer and his colleagues in the course of an experimental research into their behaviour under stress, shows that in every case the faces of the wedge are not plane but are definitely curved surfaces.

I would strongly suggest that general deductions as to the distribution and amount of slip, from geometrical considerations or from the representation of atoms by hard spheres, unless supported by carefully obtained experimental evidence, should be treated with great caution. S. J. WRIGHT.

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May 29.

Dipole Moment and Molecular Structure.

DEBYE (Marx, "Handbuch der Radiologie, **6**, 597) has shown how the electrical moment or dipole moment of a molecule can be determined from dielectric constants and refractive indices of vapours and dilute solutions. Debye and other workers find that the dipole moment for a series of homologous compounds is nearly constant. The dipole moment, therefore, may be associated with a definite polar group in the molecule, whilst the rest of the molecule is non-polar. The dipole moment is a vector quantity. Hence the dipole moment of a molecule, which contains several polar groups, should be the vector-sum of the dipole moments of the groups; compare Errera, *J. Phys. Radium, VI.*, **6**, 390 (1925).

To test the above theory the present experimental investigation has been carried out. The results are collected in the following table. The experimental dipole moment μ is calculated for infinite dilution in benzene solution. Simultaneously the association constant k may also be determined. The theoretical dipole moment v is calculated as the vector-sum of the moments of the monosubstituted derivatives, assuming the angles between the ortho, meta and para directions to be 60°, 120° and 180° respectively. The following dipole moments have been taken from earlier publications, namely, $\mu = 3{\cdot}75 \times 10^{-18}$ E.S.U. for nitrobenzene, and $\mu = 0{\cdot}43 \times 10^{-18}$ for toluene.

	μ.	v.	k.
Chlorobenzene . .	$1{\cdot}58 \times 10^{-18}$	..	0·04
Bromobenzene . .	1·56	..	0·10
Dimethylaniline .	1·39	..	
o-Dinitrobenzene .	5·95	$6{\cdot}5 \times 10^{-18}$	0·36
m-Dinitrobenzene .	4·02	3·75	0·26
p-Dinitrobenzene .	0·8	0·00	
sym Tribromobenzene	0·3	0·00	
O-Nitrotoluene . .	3·56	3·62	
p-Nitrotoluene . .	4·30	4·18	0·24
o-Chloronitrobenzene	4·25	4·75	
m-Chloronitrobenzene	3·38	3·27	
p-Chloronitrobenzene	2·52	2·17	0·07
p-Bromonitrobenzene	2·69	2·19	

The small dipole moments are not exact, because of the so-called atom-polarisation: L. Ebert (*Z. Phys. Chem.*, **113**, 1 (1925)). The polarity of groups must be due to charges on the atoms in the groups. If it is assumed that one charge is on the group and the opposite on the benzene ring, it is found, from the relative directions of the component moments, that chlorine, bromine and the nitro-group are charged in the same manner, whilst the methyl group is oppositely charged. The work is being continued.

The present work was carried out in the Chemical Laboratory of the University of Copenhagen. The author wishes to express his thanks to Prof. Billmann and to the Orsted foundation of the Great Northern Telegraph Co., Ltd., for a grant.

KRISTIAN HÖJENDAHL.

Efficient Use of Thermopiles.

IT is well known that when using a very delicate thermocouple or a thermopile for the measurement of weak intensity radiation, it is of advantage to work the pile *in vacuo*. The effect obtained is threefold: (*a*) Increased sensitivity; (*b*) Improved constancy of the galvanometer deflexions; (*c*) Increased steadiness of the galvanometer.

The value of the first is small, the factor being about three times, unless special care be taken to reduce to a minumum the conduction of heat along the wires of the thermo-elements. (Cf. Moll and Burger, *Z. für P.*, **32**, 575, 1925; also *Phil. Mag.*, **50**, 624, 1925.)

(*b*) In the absence of a vacuum, and when the total radiation falling upon the pile is great enough to cause an appreciable difference of temperature between the two sets of junctions, minute convection currents are set up in the air, with consequent fluctuation in the magnitude of the galvanometer deflexion. This trouble is not noticeable if the deflexions are small.

(*c*) This is of very real value. The major portion of the disturbance experienced in working with a thermopile in air is due to the unequal heating and cooling of the two junctions of each thermo-element, by the minute and continual adiabatic variations of pressure of the atmosphere. These disturbances become relatively very large as the sensitivity of the galvanometer used for the measurement of the thermo-electric current is increased. It may not always be convenient to work with a vacuum pile, but to secure the benefits conferred by (*c*) it is only necessary to enclose the pile in an air-tight casing, an experimental problem very much easier of solution than the construction of a casing to hold a high vacuum indefinitely. Apparently this simplification of the problem is not generally realised, and I can from my experience here vouch for the efficacy of the method.

In this connexion, it may also be of interest to note that when working with a galvanometer of the Paschen type, of a figure of merit of about 19,000, also when using a Boys' radiomicrometer, it was found possible to eliminate mechanical disturbances only when the instruments were stood directly upon a concrete pillar let into the foundations of the building. Earth tremors, etc., might then produce a temporary minute disturbance, which died rapidly away, leaving the zero unchanged; whereas if any system of suspension or mounting upon rubber in any form were used, chance earth tremors maintained the suspended system in a continual state of minute vibration.

A. MAURICE TAYLOR.

Laboratory of Physical Chemistry,
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June 5.

The Evolution of Beauty.

DARWIN sought for an explanation of the ornaments of animals, their bright colours, beautiful songs, and all their structures and habits that could not be explained as the result of natural selection, and he found a perfect one in the instincts possessed by the unornamented sex, usually the females, of choosing as mates the more beautiful of their suitors. But this theory, although it explains the ornaments by the instincts, makes no reference to the evolution of the instincts.

It seems plain that a female which gives her descendants dangerous habits and structures will soon have no descendants, yet some of the practices and structures of the males are dangerous, and the female instinct to choose these has evolved, apparently in defiance of natural selection.

The better mate an animal can get the more chance its descendants will have of survival, and it is obvious that a male that has to face more danger and yet manages to survive has in all probability a greater capacity for keeping alive than one which lives through less danger. Therefore the female that chooses a mate with a dangerous habit or structure chooses what is, apart from the dangerous part, a better and more fit mate.

No species can rise directly above its environment, for if there is less killing there is less selection, and variations for the worse soon drag the whole species down into the arena, even if it does contrive to climb out. The only way in which selection can be escaped is for some individuals to be handicapped and sacrificed, taking the selection upon themselves, so that their descendants, or at all events some of them, may escape it.

This is exactly what has happened. The female has forced the male to seek danger and endure rigorous selection in order to win her, and, while his handicap has descended only to the male line, the vitality which was his that he might bear it has descended to both sexes equally.

The whole advantage is on the female side, consequently anything which tends to make the female more valuable than the male favours the development of sexual selection. Compared with the females the males of polygamous animals are valueless, and it is noteworthy that among the higher animals all, or almost all, the polygamists indulge in sexual selection.

C. H. HENSHAW.

11 Belmont Street,
London, N.W.1, May 31.

The Line Spectra of Isotopes.

COMPARISONS of the spectra of the isotopes of lead have shown that they are indentical, except for slight wave-length differences of the order of a few thousandths of an Ångström unit. Our inability completely to separate the isotopes of other non-radio-active elements in quantities for spectroscopic investigation has left this the only experimental result of a direct nature. In order to find possible evidences of the effect in two other elements, the writer has made an accurate comparison of the spectra of samples of mercury having different atomic weights, and also of similar samples of chlorine. These have been produced by long-continued fractional diffusions in the laboratory of Prof. W. D. Harkins, who kindly made them available for this investigation.

The best mercury used had an atomic weight difference of 0·18 units. A calculation showed that the proportions of isotopes 198 and 204 in these samples differed by about 20 and 27 per cent., respectively, of their values for ordinary mercury. The lines were compared, using an echelon of R.P. 400,000 and a plane grating the R.P. of which in the fifth order was 478,000. No differences in the wave-lengths of the lines λλ5461, 4359, 4078, and 4047, or any of their satellites, were found which were greater than the error of measurement (3×10^{-4} Å.U.). The relative intensities of the satellites of a line were always visually identical in the two spectra. This observation has a direct bearing on some recent discussions which have appeared in the columns of NATURE, particularly those of Nagaoka and his associates, according to whose ideas we should expect intensity differences of 1/4 and 1/5 in the satellites corresponding to isotopes 198 and 204.

The chlorine lines from two specimens differing by 0·097 atomic weight units, when examined with the echelon, showed distinct evidence of shifts in some cases. Wherever these were observed, the heavier chlorine appeared to give the shorter wave-length. The shifts were small, however (0·0012 Å.U. in the largest of the trustworthy cases, λ4741), and their exact values cannot be given, since they were at most only two or three times the experimental error.

The experiments were carried out in the Physics and Chemistry Departments of the University of Chicago, and the writer is indebted to Prof. H. B. Lemon for many valuable suggestions. A fuller report of these results will be given elsewhere.

FRANCIS A. JENKINS.
(National Research Fellow.)
Jefferson Physical Laboratory,
Harvard University, Cambridge, Mass.

The Isotopes of Sulphur.

SULPHUR is one of the elements used in the fundamental calculation of atomic weights, and there is no reason to doubt the substantial accuracy of the fractional value 32·06 ascribed to it. The results of its analysis by the mass-spectrograph (NATURE, July 1, 1920, p. 547) were indecisive, owing to the fact that the resolving power of the instrument, about 1 in 130, was insufficient to separate the line due to molecular oxygen from that of a sulphur atom of the weight above, if the latter existed. There were many other lines on the plates, which might have been due to isotopes present in small percentages. Those at 33 and 34 were particularly noted (*Phil. Mag.* **40**, 632, 1920), but with the knowledge then available it seemed safer to ascribe these to hydrides and to rest content with the certain conclusion that atoms of mass number 32 were present in preponderating amount.

I have now been able to raise the resolving power of my new instrument to about five times that of the old one, sufficient to show the lines of O and CH_4 clearly separated by more than half a millimetre. Subject to this analysis the line 32, obtained under conditions such that O_2 and S must both have been present, showed no sign of doubling. This proved that isotopes of higher mass-number must exist. Further study with gases containing SO_2 indicated that the suspected faint companions at 33, 34 (S); 49, 50 (SO); 65, 66 (SO_2), were present on all spectra, even when the conditions were such as to make the presence of hydrides very unlikely. They also showed intensity relations consistent with true isotopic character.

The matter has now been put beyond reasonable doubt by the negative mass-spectrum obtained by using pure SO_2 and exposing for an hour with both fields reversed. All three lines were visible, and again showed the same intensity relations. Sulphur is therefore a triple element like the two even ones,

magnesium and silicon, which precede it in the periodic table. The lightest mass-number is far the most abundant in all three cases. S^{34} appears to be about three times as abundant as S^{33}; the two together probably amount to about 3 per cent. of the whole.

The band spectra of suitable sulphur compounds should well repay a careful study, since they should exhibit an isotope effect similar to that so beautifully demonstrated by Mulliken in the case of silicon.

F. W. ASTON.

Cambridge, June 12.

Numerical Reduction of Instars in the Metamorphosis of Euphausids.

THE development of an animal from the zygote up to the adult condition is usually accompanied by a more or less regular and continuous increase in size. In the case of the Arthropoda, however, the enclosure of the body in a hard inextensible layer of chitin renders this impossible, and in accordance with this the chitinous exoskeleton is shed from time to time, each moult or ecdysis being followed by a rapid spurt of growth until the process is again blocked by the hardening of the new chitinous layer. In many of the better-known arthropods particular moults are associated with the attainment of particular stages of development—*e.g.* the penultimate and the last moult of a Lepidopterous insect—and the idea is very generally held that this applies to *all* ecdyses or moults in the Arthropoda. Consequently, when in the study of plankton it is found that specimens of the young of some particular crustacean fall into a large number of different types demarcated by slight differences in size and form, one very naturally regards these as forming typical successive stages of the life-history, the whole series being worked through by each developing individual.

The object of this communication is to record that recent work at the Millport Marine Station upon the Euphausidæ would appear to invalidate the belief indicated above. From observations upon *Meganyctiphanes norvegica*, it seems clear that the individual does not necessarily go through the thirty or so moults which have been assumed to demarcate definite successive larval stages. On the contrary, the suspicion is forced upon one that the act of ecdysis does not by any means form a fixed landmark in the developmental history of the individuals. Should this suspicion turn out to be correct it will obviously involve important modification of our current conceptions of arthropod development.

R. MACDONALD.

Marine Biological Station,
Millport, May 19.

Abraham de Moivre.

TRAVELLING in countries where NATURE was not available in public libraries, it was not until to-day that I was able to consult the issue of April 17, in which my letter, with Prof. Pearson's comments, appears. I must decline to accept responsibility for the statement attributed to me by Prof. Pearson, namely, that I spoke "as if the matter in the 1738 'Doctrine of Chances' and again in the 1756 edition was a mere translation 'except for minor changes.'" What I *did* write was that a translation of the pamphlet under discussion appeared, except for minor changes, in both editions. I still believe this statement to be absolutely accurate. It is, of course, true that after this translation there are in the 1756 edition of the "Doctrine" 'Remarks,' and other material. Prof. Pearson regards the Remarks as of great historical importance. I am glad that in this connexion my letter drew forth his further comments on the history of statistics.

May I add that my letter was written with a photographic copy of the pamphlet before me, as my reference to the *Isis* article indeed suggested. Typographic considerations, which Prof. Pearson suggests, would scarcely lead me to his conclusion. But in the light of Moivre's positive statement that the contents of the pamphlet were first "made public" in 1738, it does not appear to me possible to consider the earlier pamphlet, "communicated to some Friends," as a second supplement to the "Miscellanea" of 1730.

I closed my last letter with the sentence, "It would be interesting to learn if any other copy of Moivre's original pamphlet is in existence." I have here found another copy in the Preussische Staatsbibliothek, bound in with the "Miscellanea." Are there other copies?

R. C. ARCHIBALD.

Berlin, June 2.

The Taxation of Research.

IN "News and Views" of NATURE of June 19, p. 866, it is stated that there is a "semblance of overstatement" in our letter on the above subject published in the same issue. In justice to the Chemical Society we think this remark "requires some slight modification."

The published balance sheet of 1925 is quoted as illustrating the financial position of the Society, but had the balance sheets for previous years been examined as well, it would have been found that the *actual* deficits on the years' workings were as follows: 1920, 2853*l.*; 1921, 1104*l.*; 1922, 584*l.*; 1923, 1628*l.*—a total of 6169*l.* in four successive years, despite the raising of the subscription from 2*l.* to 3*l.* in 1921. It was only by drastically cutting down published papers—even to the point of unintelligibility—that we were able to obtain a credit balance of 210*l.* in 1924 and another of 466*l.* in 1925, the latter including, however, a grant of 350*l.* from the Government Publications Grant.

It is clear that in these circumstances "solvency and bankruptcy" are closely related to "surplus and deficit" on the year's working, and that even the substantial sum given as invested capital cannot long withstand depletion at the rate illustrated above.

H. B. BAKER, President.
JOCELYN THORPE, Treasurer.

Royal College of Science, South Kensington,
London, S.W.7, June 21.

Frictional Forces in Liquid Surfaces.

MR. CHASE in NATURE of May 22, p. 724, deals with a phenomenon which probably many have noticed. The effect produced is, I think, due entirely to the surface tension of the liquid acting on the wire where it breaks the surface.

Unless the liquid surface be of large extent a resultant force is in general set up on the wire in the plane of the surface, and if the axis of rotation of the moving system does not meet the surface in the same point as the wire, free rotation is impeded.

This form of apparatus gives a great deal of trouble in use, for the forces set up may be comparatively large. It is of course theoretically possible to find the neutral point in the surface and to adjust the axis of rotation and the suspended wire so that they both pass through it, but these adjustments are difficult to maintain, and observations made with the apparatus are liable to a very uncertain source of error.

L. H. G. DINES.

73 Fairfax Road, Teddington, June 6.

The Light-Quantum Theory.[1]

By Dr. C. D. ELLIS.

IT is well known that the wave-theory of light fails to explain certain phenomena, and so much has been written on this subject already, that it seems at first sight unnecessary to emphasise this point. But although the main problem has not altered and no solution has been found, yet the general attitude towards this question is slowly changing, and several important new experiments have been carried out. Recently a new theory was put forward by Bohr, Kramers and Slater which would have removed many of the difficulties, but experiments by Geiger and Bothe quickly showed it to be incorrect. This theory and its refutation were not without their effect, and now the attitude is frequently held that the light-quantum theory is not merely a crude picture of certain facts, but is an important theory no further from the truth than the wave-theory. The wave-theory itself cannot be correct, but except for its greater age it has no greater claims than the light-quantum view.

These two theories give entirely different pictures of the nature of light, as is expressed by their names. The wave-theory pictures the radiant energy as spreading out in all directions from the source, filling every portion of the surrounding space, so that the propagation may be imagined to be a handing on of the energy from point to point. It is an essential feature that except in special cases the intensity of the forces in the light wave diminish rapidly with increasing distance. Any theory will predict that the average energy density will diminish with the inverse square of the distance, but the law of variation of the forces is peculiar to each theory. The triumphs of the wave-theory scarcely need emphasis. By its means all the intricacies of interference and diffraction problems can be explained in the smallest detail, and in every problem involving direction this theory is in complete agreement with experiment.

It is only when we consider the interchange of energy between radiation and single atoms that the wave-theory breaks down, and the completeness of this breakdown is best seen by considering the photo-electric effect. To take a definite case, suppose X-rays are incident on a plate of some material, then it is found that electrons are ejected from the plate with considerable velocities. The number of electrons depends on the intensity of the X-rays and diminishes in the usual way as the plate is moved farther from the source of X-rays. The velocity or energy of each electron, however, does not vary but depends only on the frequency of the X-rays. The electrons are found to have the same energy whether the material from which they come is close to the X-ray bulb or whether it is removed away to any distance.

This is a result which is quite incompatible with the ordinary wave-theory of radiation, because as the distance from the source increases the radiation spreading out on all sides becomes weaker and weaker, the electric forces in the wave-front diminishing as the inverse square of the distance. The experimental result that the photoelectron always picks up the same amount of energy from the radiation could only be accounted for by giving it the power either to collect energy from a large volume or to collect energy for a long time. Both of these assumptions are unworkable, and the only conclusion is that the radiated energy must be localised in small bundles.

This is the basis of the light-quantum theory. Light of frequency ν is considered to consist of small bundles or quanta of energy all identical and of magnitude $h\nu$, h being Planck's constant. These quanta travel through space, being unaffected by each other, and preserving their own individuality until they make a suitable collision with an atom. Then if the quantum is absorbed the whole energy is transferred to the atom and an electron will be ejected. It can be seen that this hypothesis is so designed that the velocity of the photoelectrons is accounted for, first in the dependence on frequency, since the energy given up is always just one quantum, which bears the correct proportionality to the frequency; and secondly in its independence on the distance from the source, since although when the source is distant fewer quanta will arrive, those that do arrive will still give up the same invariable amount of energy to the atom.

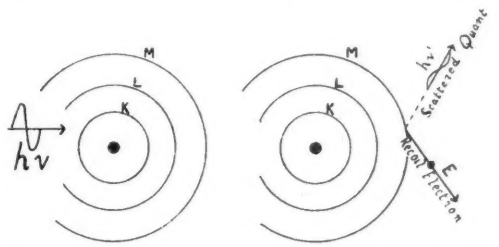

FIG. 1.—Diagrammatic representation of the mechanism of the scattering of X-rays in accordance with the relation $E+h\nu'=h\nu$.

This theory is also capable without further modification of accounting for the Compton effect. Compton found that X-rays suffered a change of wave-length when they were scattered. Now, scattering on the light-quantum hypothesis means a deflexion of the quantum, and since this quantum with its energy $h\nu$ will have momentum $h\nu/c$ where c is the velocity of light, this means further that the electron which deflects it will receive an impulsive blow. Fig. 1, in which the orbital electrons of the atom are represented by concentric rings, illustrates such a process. The left-hand picture is supposed to represent the quantum just about to collide with an electron in the M ring. The right-hand picture indicates how the quantum is deflected and sends off sideways the electron with which it collides. If, as the hypothesis demands, we consider energy to be conserved, then the energy of the scattered quantum plus the energy of the recoil electron must equal the energy of the initial quantum. In other words, the scattered quantum must have a smaller energy, which means lower frequency (since

[1] Substance of three lectures on "The Atom of Light and the Atom of Electricity," delivered at the Royal Institution on February 25 and March 4 and 11.

energy $= h\nu$) or longer wave-length. The theory at once suggests the simple qualitative result of Compton's experiments, and it is a striking point that the consideration of the simple dynamics of the collision lead directly to a complete quantitative agreement also.

It can be seen that the light-quantum theory explains two important phenomena, but in this crude form it fails to give any explanation of diffraction and interference just as completely as the wave-theory fails to explain the photoelectric effect. These two theories are clearly incompatible, and many attempts have been made so to modify either one or the other that it might explain the rival phenomenon. We find modifications of the wave-theory which attempt, on the whole unsuccessfully, to account for photoelectric phenomena; and again, there is another class of theories which make arbitrary rules to direct the light-quanta along such paths as would be necessary to give the correct interference patterns.

The most serious theory of the first class has been proposed by Bohr, Kramers and Slater, and it must be held greatly to the credit of this theory that it was sufficiently precise in its statements to be disproved definitely by experiment. The Bohr theory took its origin from the observation that it was only in the prediction and explanation of the energy relations that the wave-theory failed, and this failure could be briefly stated by saying that on the wave-theory there is never enough energy at the right place to produce the observed changes. These authors therefore suggested that energy might not necessarily be conserved in each interchange of energy between an atom and radiation, but only when a very large number of such interchanges were considered. For example, an atom which was in a radiation stream of frequency ν could suddenly acquire energy $h\nu$ by means of the action of the radiation, although the energy density of the radiation might be so small that this amount of energy could only be found in a volume a million times greater than that of the atom and there would be no possibility of imagining any kind of collecting process. However, if a very large number of such processes were considered, then the total amount of energy abstracted from the radiation would be equal to the energy absorbed by the atoms.

The merit of this theory was that it rendered possible the calculation of the probabilities of such processes in a manner analogous to the calculations of absorption and emission on the pure wave-theory. It promised such a complete solution of the difficulty that immediately experiments were started to test its accuracy. One such experiment was carried out by Geiger and Bothe on the phenomenon of the Compton scattering, which has been referred to above. The essential features are that when X-rays are scattered the scattered radiation shows an increased wave-length and low velocity electrons are liberated from the scattering atoms. The energy relations in this process are those that would be expected if a light-quantum endowed with mass and momentum were to collide with an electron and be deflected. As a result of the collision the electron will be driven sideways, forming one of the recoiling electrons. It is clear how the light-quantum theory predicts definitely that to every scattered quantum there must occur at the same moment a recoiling electron. On Bohr's theory these two events would not occur at the same moment, there would be no detailed connexion between any one recoiling electron and any particular portion of the scattered radiation. All that is required is that, on the average, energy should be conserved. From this it may be seen that a decision between the two theories will be reached if it is possible to settle whether to each recoiling electron there corresponds a scattered quantum, or whether the scattered radiation is radiated continuously.

Geiger and Bothe directed a stream of X-rays on to a small volume of hydrogen, and on either side of this were arranged two counters. These consisted of small chambers charged to a high potential with an inner insulated electrode. When a single electron traverses the gas in such a counter there is a sudden flow of electricity to the electrode, which may be registered by a suitable instrument. One counter was open to receive the recoiling electrons, the other was to register the radiation, and was closed by a thin metal foil. On the light-quantum view we should say that the quanta incident on the foil will sometimes eject an electron into the counter, which will then register it. Since every recoiling electron must be accompanied by a scattered light-quantum there should be a detectable number of coincidences between the indications of the two counters. On Bohr's theory the scattered radiation comes off in a continuous stream, and passing through the metal foil on the face of the counter, will from time to time liberate electrons. Although on this theory there should be just as many electrons liberated as on the previous theory, the important point is that now the secondary electrons will have no direct connexion with the recoiling electrons, and there would be no reason to expect coincidences between the indications of the two instruments.

The result of this experiment was decisive; undoubted coincidences were found to occur between the indications of the electron counter and the radiation counter. This could not be accounted for on Bohr's theory, which consequently had to be abandoned. But at the same time it provided additional support for the light-quantum view, although it certainly is not a proof of its correctness.

Bothe has recently carried out a further experiment on similar lines which is specially interesting, since in this case Bohr's theory would predict coincidences whereas the light-quantum theory would not. A small piece of iron foil was placed between two 'radiation' counters and radiated with X-rays so that it emitted its own characteristic radiation. If this radiation consisted of localised quanta, then it is clear that any one quantum could go into either one counter or the other, but it could not possibly be absorbed in both counters at the same time, and there should be no coincidences between the indications of the two counters. On the other hand, if the characteristic radiation from the foil spreads out in a spherical wave, this wave will pass through both counters at the same time, and occasionally will stimulate an absorption act in both counters simultaneously, so that on this theory coincidences should be found. Experiment again

decides definitely against the theory of Bohr, Kramers, and Slater, and gives the result that would be expected on the light-quantum view. This is the fate of the most serious theory which has attempted to solve the fundamental difficulty by preserving the wave-theory but altering our pictures of the absorption and emission of energy by atoms.

There is another group of theories which postulate that radiation consists of discrete quanta. Thus they explain automatically the photoelectric effect and the Compton scattering, and then attempt to account for diffraction and interference by laying down rules which shall determine the paths these quanta shall follow. The light-quantum theory accounts for all the effects once the quanta are got to the right place, but in its crude form it gives no suggestion of the quanta moving in anything but straight lines, and it is only the wave-theory which predicts successfully the directions in which light travels. Hence theories have been proposed which provide 'tramlines' along which the quanta move, and these 'tramlines' are so arranged that in a system of interference bands 'tramlines' only lead to the bright bands and none to the places of zero intensity. To be more precise, the 'tramlines' are supposed to be the paths of the Poynting vector of a virtual radiation field emitted by the atoms, and the probability of a quantum travelling along a given path is connected with the value of the Poynting vector along that path. Such theories meet with many difficulties, and no one has yet been carried to the point where it can be tested by experiment.

This has been discussed in detail recently by Prof. G. N. Lewis in an article in NATURE (February 13, p. 236), in which he also puts forward an original view on the whole problem It is a striking fact that while all the theories are directed towards explaining the propagation of light, one theory suggesting that it occurs in the form of waves, the other in the form of corpuscles, yet light has never been observed in empty space. It is quite impossible to observe light in the course of propagation; the only events that can ever be detected are the emission and absorption of light. Until there is some atom to absorb the radiation we must be unaware of its existence. In other words, the difficulty of explaining the propagation of light may be because we are endeavouring to explain something about which we have no experimental evidence. It might be more correct to interpret the experimental facts quite directly and to say that one atom can transfer energy to another atom although they may be far apart, in a manner analogous to the transference of energy between two atoms which collide. Prof. Lewis says: "I shall make the contrary assumption that an atom never emits light except to another atom, and that in this process, which may rather be called a transmission than an emission, the atom which loses energy and the atom which gains energy play co-ordinate and symmetrical parts."

On this view the fringes in an interference system are to be regarded as forming one system with the source in the sense that the atoms which absorb the light at the bright fringes are in 'virtual' contact with the atoms in the source, whereas those in the dark fringes or any place where the light does not go are not in virtual contact. On this view there would never be any discussion as to where radiation goes, but only as to which pair of atoms could make up an emitting and absorbing couple.

The foregoing shows clearly that there is at present nothing approaching a complete theory of light, but yet it must be remembered that it is an important practical achievement that a complete description can be given by means of two theories, providing the appropriate theory is used for each phenomenon. Both these theories have more than justified the care and trouble spent on their elaboration by the help they have given to experimental work, and also on the theoretical side they represent an important advance in our knowledge of light. It would not be right to deduce that both theories are necessarily incorrect; it might be closer to the truth if we were to compare them to the plan and elevation of an engineering drawing. The wave-theory and the quantum-theory may be just the plan and elevation of the true theory of light, and the marked contradictions between them may be due to the language we use to describe the experimental results, just as the differences between a plan and elevation reflect our attempt to describe in two dimensions a three-dimensional object.

The Origin of Petroleum.

By HENRY B. MILNER.

EVERY branch of natural science possesses its quota of time-honoured problems awaiting solution; these serve to maintain an essential stimulus to contemporary thought and to animate that discussion from which progress alone is possible. Controversy, however, unless confined within legitimate bounds of clear issues, is prone to irrelevancies and digressions to an extent that, proverbially, the 'forest' of significant observations tends to be blurred by the 'trees' of individual conjecture and detail: thus is truth obscured and explanation postponed. So it is with the science of petroleum; the problem of its genesis remains paramount, partly because there are more hypotheses than even plausible solutions based on fact, mainly for the reason that the real perspective of the problem is being lost in the maze of accumulated detail and argument. It was not only appropriate but essential that, to avoid further confusion, some one should see round rather than into the problem of mineral oil origin, that the ground should be cleared by correlation of definite data of constructive theories, thus propounding a unified hypothesis from which future research could trend with some hope of positive results. It is from this viewpoint that Mr. Ernest Clark has surveyed his subject, and his thesis (presented to the Institution of Petroleum Technologists on May 25) more than justifies his entry into this difficult field of debate, chiefly by his careful analysis of the situation, by his elimination of the unessential, and by his attempt (entirely successful) to point the way.

At the outset the author tacitly discards all theories of inorganic origin of petroleum, so that we are saved the boredom of recapitulation of text-book paragraphs. He takes his stand on organic theories, and in this the majority is undoubtedly with him. We have to realise that oil formation is as much a definite and normal phase of sedimentation as that of coal, and that no curious mechanism or exceptional process has to be invoked to explain its existence. Thus, just as in studying coal our attention is directed mainly to its mother-substance and the biochemical changes whereby that substance has been made to assume its present form, so with petroleum the problem of genesis is essentially one of the nature and deposition of mother-substance and the subsequent chemical and biological reactions involved in its metamorphosis.

Those classes of organisms which, by their nature and abundance, are potentially favourable as constituents of the mother-substance of oil, belong both to the animal and vegetable kingdoms; of the latter, algæ, diatomacea, and bacteria comprise the planktonic forms, though benthonic forms contribute, such as the seaweeds; water ferns (rhizocarps), terrestrial, fresh-water, and salt marsh grasses may be similarly contributive. Of the animals, foraminifera, corals, mollusca, and fish are mainly concerned in the supply of requisite materials; planktonic, vagrant benthonic, and normal benthonic foraminifera are alike prolific and significant; corals are sedentary benthonic forms of warm marine habitat, possibly of less importance; molluscs favour a shallow water, often a muddy environment, and are accordingly suggestive, while fish, being both marine and fresh-water nekton, are abundant in shallow seas and continental shelves, significant also in their pursuit of essential planktonic food. Thus we perceive the existence of proteins, fats, and carbohydrates in varying proportions in the mother-substance of oil, carbohydrates (cellulose, etc.) characteristic of plant contribution, proteins and fats of animal ingredients. Restriction of any one form, either animal or vegetable, is, as the author shows, dependent on environment, though from a chemical viewpoint fats, either of foraminiferal or algal origin, are conceivably the most important sources of mother-substance.

Decomposition of such organic matter implies mainly oxidising reactions; the rate of oxidation varies necessarily with the available supply of oxygen in the aqueous environment, and here we perceive a selective factor capable of segregating matter of similar chemical composition from a chemically heterogeneous organic mass; some foundation of uniformity in certain important constituents of petroleum may possibly be traceable to this. Again, abundance of marine life depends largely on adequate supply of planktonic food as well as on sufficiency of oxygen; thus conditions creative of or sympathetic to high organic mortality (hence plentiful supply of mother-substance), tend to favour rapidity of oxidation of the organic matter. "The association of prolific micro-organic remains with strata which are believed to have produced petroleum is of very frequent occurrence, and due significance should be attached to this fact."

In the matter of organic deposition, gulf and inland sea conditions seem to be most favourable, evidenced by a study of many Tertiary oil-fields. These environments often imply rapid and fluctuating sedimentation, sometimes with restricted oxidising influences. Though in this connexion the author did not consider the circumstances of palæozoic deposition, instanced by the great oil-fields of North America, these occurrences do not imply manifestly dissimilar environments, if visualised on a sufficiently large scale; the nature and process of organic contribution are certainly parallel.

The association of petroleum with brine is almost universal, and this 'indication' has to be stressed. The theory that such brines represent partially altered connate waters would seem to be nearest the truth, especially when it is remembered that compaction of the salt-water saturated sediment and implied orogenic movement would cause circulation of such connate fluid, afterwards diluted by meteoric fresh-water infiltration, a factor to the migration or removal of oil and gas.

The data of chemical change of organic matter to petroleum are yet obscure, despite the mass of experiment. Putrefaction by bacterial influence is at least a reasonable starting-point; thereafter the reactions would seem to be largely micro-biochemical. A simple pressure-heat distillation as a process is untenable, at least as a general mechanism, in view of observed facts, such as the absence of a common vertical gradation of oils in the field. The necessary reactions might be expected to take place at low temperatures, not above 150° C., possibly much lower; but throughout, some kind of bacterial control would seem to be strongly indicated, quite apart from the influence of extraneous geological circumstances, such as type of sedimentation, presence and potency of colloidal matter, and so on.

Ultimate composition of a crude petroleum thus becomes a function of the initial nature of the mother-substance, its environment and mode of deposition, and the chemical reactions which transform this material into petroleum hydrocarbons, also to some extent of the changes occasioned by the contact of the oil with different rock-types and with subterranean waters. From this point of view the author defines the essential directions of future research; these involve careful investigation of sediments forming at the present time, detailed knowledge of lithology and palæogeography of petroliferous sediments, also of the controlling factors to the movements of oil, gas, and brine in such sediments; from these results it is contended that chemical problems would probably be outlined. It would seem to be unnecessary, however, to await the result of geological investigations before defining or studying the chemical problems, since these, at least, are equally formidable. Clearly the work is that of biochemists and bacteriologists, quite apart from the other specialists envisaged, and the sooner such co-operation is brought about, the sooner will emerge critical data. We have more than once stressed the value of such collaboration with geologists engaged on these 'border-line' problems; while the author's work marks a step forward in disposing of irrelevant theory and useless detail, and in focussing attention on the essential organic origin of petroleum, it does equal if not greater service in clearing the ground for a corporate effort from which a true solution to this fascinating problem alone can spring.

Obituary.

SIR WILLIAM B. LEISHMAN, K.C.M.G., C.B., F.R.S.

THE death of Sir William Leishman after a brief illness is one that will be widely and keenly felt in many circles, scientific and military, and not least by the corps to which he had given a lifelong devotion and to whose headship he had attained by sheer merit and force of personality three years before his death. His decease also breaks the circle of Service officers whose labours have opened up new ground in tropical medicine.

A medical graduate of Glasgow, Leishman entered the medical service of the army in 1887, but it was not until ten years later that the call to the laboratory life came to him and we find him installed at Netley at the feet of Sir Almroth Wright and Sir David Semple. With Semple's removal to India in 1900, Leishman became assistant professor of pathology, and in 1903, with the disbandment of the Netley laboratory, he came to London to be professor of pathology at the Royal Army Medical College, a post he retained until 1913. The War gave Leishman abundant scope for his administrative qualities, particularly in the organisation and supervision of bacteriological services in France, which proved such indispensable units in the general scheme of military medicine and hygiene. When the Director-Generalship of the Army Medical Service became vacant in 1923, it was pleasant news to many that one whose reputation rested on his achievements as a scientific worker and teacher had been raised to this important post, which, we believe, Leishman was filling with great acceptance when the end came.

It is appropriate here to refer mainly to Leishman's scientific labours, two at least of which have made his name a household word in medical science. These were his modification of the Romanowsky staining procedure in 1901 and his description for the first time in 1903 of the Leishman-Donovan bodies, the specific protozoal agent of kala-azar and tropical sore and other forms of leishmaniasis which have since become known.

The method of Romanowsky staining, now so indispensable an aid to parasitological and hæmatological technique, was, when first introduced, a cumbrous and perhaps somewhat uncertain procedure. Leishman conceived the idea of securing in one stain the product obtained by the interaction of methylene blue and eosin and dissolving that product in methyl alcohol. This solution both fixed and stained the preparation at the same time, and by the addition of distilled water at a certain stage in the process, a picture was obtained in which the chromatin material present took up the characteristic Romanowsky tint.

Leishman's stain gained wide fame and use and is still largely employed, though for certain purposes modifications such as that of Giemsa are preferred. It was admittedly the use of Romanowsky staining in the form modified by himself which enabled him to obtain a clearer picture of the structural details of the curious bodies the real nature of which had perplexed him for three years. These bodies he had observed first in spleen smears from a fatal case of obscure splenomegaly invalided from Dum-Dum, near Calcutta, to Netley. That they were protozoal parasites he had no doubt when he finally published his description of them in 1903, and he hazarded the opinion, based on observations of the forms assumed by trypanosomes in the blood and organs of rats which had died of experimental Nagana infection, that the bodies pointed to the presence of trypanosomiasis in India—or at least some form of trypanosomiasis in which the fully-developed trypanosome might only rarely make its appearance in the blood stream.

The description by Leishman appeared in May 1903, and in July came an announcement from Donovan confirming Leishman's observations in certain cases of obscure splenomegaly in Madras. Shortly afterwards was reported the finding of similar bodies in tropical sore (Delhi boil) and in the disease known as kala-azar in Assam. Kala-azar, in fact, was proved, by the finding of the parasite, to have other foci outside its main home in Assam.

The writer of this notice may be pardoned for alluding to the finding of these bodies by Marchand and him in the organs of a German soldier returned from the Boxer campaign who died in a Leipzig hospital in December 1902. In their description by Marchand in March 1903, the only opinion that was hazarded was that the bodies might represent some unique form of nuclear degeneration of spleen cells in the obscure symptom-complex known as splenic anæmia—an opinion that was promptly revised when the communications of Leishman and Donovan came to their knowledge later in the year. The Leipzig case pointed to the presence of kala-azar in China, since then a well-recognised centre.

Leishman's view that the Leishman-Donovan bodies represented some form of trypanosomiasis had much to be said for it, and the subsequent discovery by Rogers that flagellate trypanosome-like forms developed from the L.-D. bodies in artificial culture, appeared to lend considerable support to the contention. The view, however, of Ronald Ross, expressed in November 1903, that the Leishman bodies represented a new genus of parasites and not a species or phase of trypanosome, proved the correct one as time went on. Leishman himself in September 1904 directed attention to the similarity of the flagellate forms found in culture of the L.-D. bodies with the herpetomonas known to be present, for example, in the intestinal tract of the house-fly. Though this interesting connexion of the L.-D. bodies in cultural phase has been kept in view for more than twenty years, it is only within recent months that the problem of transmission seems in a fair way to solution, the most probable insect vector being a species of sand-fly.

Leishman made other important contributions to tropical medicine, particularly in connexion with tick fever and the granular changes which take place in the spirochætes within the body of the tick after an infective feed. The precise significance of these "infective granules" is not yet completely understood.

The association of Leishman with Sir Almroth Wright at Netley in the closing years of the nineteenth and the early years of the twentieth century was the means of introducing him to the great problem of antityphoid vaccination, a measure now so potently

vindicated by the experience of the War. In 1902 Leishman described a method of estimating quantitatively the phagocytic power of the leucocytes in infection with the view of supplementing the bactericidal tests which had been hitherto mainly employed as criteria of acquired immunity. The technique formed the basis of the method employed by Wright and Douglas (1903) in their analysis of the factors which determine the phagocytosis of micro-organisms in the presence of normal serum. The appointment by the Army Council in March 1904 of the Antityphoid Committee "to investigate the practical prophylactic and therapeutic value of current methods of immunisation against enteric fever," gave Leishman and his enthusiastic band of collaborators abundant opportunity for experimental investigation during many busy years. Questions such as the preparation and standardisation of the vaccine, the relative efficiency of vaccines prepared in different ways, their keeping quality, the antibody response to them in the inoculated, and many other cognate questions were submitted to experiment both in man and animals. Thus when the War came, all was *en train* for the prompt institution of this beneficent preventive measure.

When the War closed, Leishman became the first Director of Pathology at the War Office, a post which he held until his appointment in 1923 to be Director-General of the Army Medical Service. The influence of Leishman as a teacher and scientific worker was an asset of incalculable value to his corps, and that influence will, we trust, go on to further fruition. The fellowship of the Royal Society came to him in 1910, and many distinguished orders thereafter. His outside interests were many, and of committee and commission work he took his full share. He was a polished and ready speaker, ever a helpful and courteous colleague, and in his little leisure he found time to indulge his love of art and music and the pleasure of tending his Croydon garden. J. C. G. L.

Sir Frederick Mott, K.B.E., F.R.S.

Psychiatry has suffered a very grievous loss by the death of Sir Frederick Mott on June 8. To the last he was occupied by his researches, and in spite of advancing years he was a leader of scientific thought in the allied provinces of physiological psychology and psychiatry.

The earlier work of Mott on the physiology of the central nervous system belongs to that period when there was still much to be done by the successors of Fritsch and Hitzig in the field of cortical localisation, and his researches with Schäfer are among the foundations of our knowledge of cerebral physiology. From the motor cortex he turned to the study of sensory representation, and his work with Sherrington on the apæsthetic limb was a great contribution to our knowledge of the sensory component of motor activity. His brilliant studies on the anatomy of the spinal encephalic system and the thalamic connexions of the fillet led up to the classical work on the architecture of the cerebral cortex.

Mott's interest in the pathology of the nervous system was determined by his appointment as pathologist to the London County Council Mental Hospitals in 1898. When working in the Central Laboratory, then situated at Claybury, he had access to the enormous amount of pathological and clinical material furnished by the whole group of London mental hospitals. His first great work in this field was to study the pathology of general paralysis, the one psychosis that was then recognised to be associated obviously with concomitant bodily change. Although the syphilitic origin of general paralysis had been pointed out by Krafft-Ebbing, this etiology was only accepted by a small minority of psychiatrists in Great Britain. These were the days before the Wassermann reaction, and Mott set himself definitely to prove Krafft-Ebbing's thesis by a close study of a great mass of pathological data and by clinical observations. As a result of his epoch-making research the syphilitic origin of general paralysis was proved beyond all cavil, and this paper was followed by studies on the relation of syphilis to other forms of insanity and to tabes. The whole of this work was published in the first volume of the *Archives of Neurology*, which he founded.

From his work on general paralysis Mott became firmly impressed by the idea that bodily changes are to be found in all types of psychosis, but he recognised that it was not probable that the functional disturbances of the majority of the psychoses would be shown by the relatively coarse methods of investigation practised in the pathological histology of the nervous system. He turned his attention, therefore, to the bodily mechanisms which exhibited the organic resonance to emotion in the hope that disturbances of the affective states would be sufficiently pronounced at a period of the disease when the higher centres were less affected. Dementia præcox offered the most promising field of study, and in a series of papers on the pathology of the gonads and other endocrine organs and the vegetative nervous system in this disease, he was able to demonstrate with certainty the existence of a widespread degenerative change preceding the far slighter evidences of degeneration that could be detected in the central nervous system in advanced cases. In other psychoses similar though less marked pathological changes were encountered. Mott, however, was a profound disbeliever in the attempts to relegate the psychoses into sharply-defined classes. He considered that though the signs of structural impairment were most obvious in dementia præcox, there was not clinically or pathologically any hard-and-fast line between this and other psychoses. He was well aware that the methods of pathological anatomy could only furnish evidences of relatively gross changes, and he turned to the study of the biochemistry and physics of the central nervous system.

Though Mott later greatly modified the conclusions that he drew from the attempts which he made with Halliburton to demonstrate the existence of products of nervous degeneration in the cerebral spinal fluid, this work, which he published in his Croonian Lectures, was important as the starting-point of many subsequent investigations into the chemical pathology of the nervous system.

As a consultant neurologist to a clearing hospital for war neuroses Mott's attention was diverted for a time from the psychoses to the neuroses. A study of the previous

histories of the various sufferers from war neurosis convinced him that in the overwhelming majority of the cases there was definite evidence of the pre-existing functional instability of the nervous system. He predicted that an investigation into the physiological activity of the mechanisms of the motor system in such cases would reveal functional abnormalities, and work done in his laboratory from the point of view of the physiological psychologist certainly tended to support this view. Mott considered, then, that a neurosis was the response of an abnormally constituted organism to environmental stress which could be safely encountered by the normal individual, and he looked for such abnormalities of function rather in the emotional mechanisms and the various glandular organs that subserve them than in the higher nervous strata.

These views on the pathogenesis of the psychoses and neuroses are only now beginning to make themselves felt. At the time at which they were published, students of psycho-pathology, owing to a curious confusion of thought, seemed to have regarded the formulation of the anatomical and physiological disturbances found in the psychoses as an attempt to translate thought into terms of nervous mechanism. The real importance of this work is that it enables us to build up a pathology for the psychoses on the lines that have already been firmly established for the various toxæmic psychoses and for syphilitic insanity.

In the actual study of disorders of conduct Mott followed the methods of the less extreme school of behaviourism. He thoroughly distrusted the results of the various schools of psycho-analysis on methodological grounds, but he did not consider that his discoveries on the pathology of the nervous system had any direct bearing on the admissibility of their views. He considered that the majority of the pathological changes he had discovered in insanity are congenital, and instituted a very extensive inquiry into the genealogy of the cases in the London mental hospitals. As one of the fruits of his investigation he enunciated the "Law of Anticipation," in accordance with which the onset of the psychotic symptoms appears earlier in the successive generations of a degenerate family, and thus ultimately, owing to the production of infertile juvenile psychotics, the tainted stock disappears. He had more faith in the efficacy of this natural method for the elimination of the mentally unfit than in segregation or sterilisation. He pointed out that in the earlier generations of an insane family the psychosis is as a rule not evident until after much damage has been done by the breeding of tainted progeny.

Mott's work in the field of hospital hygiene is less widely known, but it is in a great measure due to his energy and teaching that dysentery in mental hospitals is almost a thing of the past.

The great work that Mott did for the teaching of the scientific aspects of psychiatry constitutes one of his greatest services to society. He was fortunate in possessing the esteem and friendship of a great clinical psychiatrist, Dr. Henry Maudsley, and when Maudsley proposed to found a hospital for the investigation and treatment of the early forms of mental disease, it was in order that it should be under the supervision of Mott that he gave the necessary endowments to the London County Council. After many years of difficulty, the Maudsley Hospital for Early Mental Diseases was opened at Denmark Hill, and the Central Pathological Laboratory was transferred there from Claybury. It was here in the concluding years of his service as pathologist to the London Mental Hospitals that Mott instituted a school of psychiatrical medicine, one of the functions of which is to prepare the younger psychiatrists for the examination for the Diploma of Psychological Medicine, which has been instituted thanks to his efforts. Mott continued to teach enthusiastically in the Maudsley Hospital to the end, and acted as the director of a similar school of psychiatry in Birmingham, and he was on a visit thither when he had the cerebral seizure from which he died.

Mott was at the disposal of any one who sought his advice, and did much to assist younger men by suggestions and criticism. He was possessed of a sturdy common sense and preserved to advanced years a keen scientific acumen combined with a phenomenal receptivity for new views and facts. He was a man of wide culture, and his great kindliness and sincerity endeared him to all.

SIR HENRY MORRIS, BART.

SIR HENRY MORRIS, who did more than any man of his time to open up the field of renal surgery, died in London on June 14 in his eighty-third year. On February 11, 1880, when he had become full surgeon on the staff of Middlesex Hospital, he removed a stone from the kidney of a patient, this being the first time that a deliberate operation had been performed for such a purpose. The operation was successful, and has become the type of a procedure now adopted by surgeons all the world over. When he gave Hunterian Lectures at the Royal College of Surgeons in 1898, he was able to cite the results he had obtained from 267 operations carried out on the kidney. It is true that Gustav Simon of Heidelberg performed the first operation for the removal of a diseased kidney in 1869, and that this operation had been frequently and successfully repeated before 1880, but it was Morris who demonstrated that one of the commonest of disorders from which the human kidney suffers—the presence of renal concretions—can be safely cured by surgical procedure.

Sir Henry Morris was, however, a general surgeon in the best sense of the term and contributed to all branches of surgical art. He came of Welsh ancestry; his grandfather was a surgeon in Oswestry, and his father in Petworth. He was dark in hair and complexion, and massively framed in head, body and limbs, a good exemplification in the flesh of the type which Mr. "Punch" has chosen to represent as "John Bull." He was a man of decided opinion, resolute in his policy, never afraid of opposition, and public-spirited to a high degree—often seeking the columns of the *Times* to guide opinion in educational, medical, social and political matters.

Epsom College and the University of London provided the opportunities of Sir Henry Morris's education, and he repaid both by giving them his unstinted services; he took an abiding interest in the welfare of

Epsom College, acting as its treasurer for many years. His medical education was obtained at Guy's Hospital, but his life's work was spent in the wards of Middlesex Hospital, to which he became assistant surgeon in 1871. There he did much to direct attention to the urgent need of research into the nature of cancer, and took an active part in founding the Imperial Cancer Research Fund.

Sir Henry Morris was also an anatomist. He lectured on human anatomy in the Medical School of Middlesex Hospital, and in 1893 edited a very successful "Treatise on Human Anatomy." An earlier work on the "Anatomy of Joints" is still a book of reference; it contains many original observations.

In 1893 Sir Henry was elected to the council of the Royal College of Surgeons of England, serving as president for three years, 1906, 1907, 1908, a baronetcy being conferred on him then. He delivered the Hunterian Oration in 1909, in which he compared the respective merits of the inductive and deductive methods of philosophy. He served on the General Medical Council, becoming treasurer to that body, and in 1910 was elected president of the Royal Society of Medicine. He was one of the outstanding figures in modern surgery, and a leading authority on medical education.

WE regret to announce the following deaths:

Prof. E. Babák, professor of physiology and general biology in the Masaryk University and Veterinary School in Brno, known for his work on the regulation of respiratory movements and also on the influence of endocrine glands on amphibian metamorphosis, on May 29, aged fifty-three years.

Prof. J. J. Flather, head of the department of mechanical engineering at the University of Minnesota and vice-president in 1902 of Section D of the American Association for the Advancement of Science, on May 14, aged sixty-three years.

Dr. C. Hering, a pioneer in electro-chemistry, who was one of the founders of the American Electrochemical Society in 1902 and in the same year began a movement which resulted in the foundation of *Electrochemical Industry*, on May 10, aged sixty-six years.

Prof. A. Magnin, formerly professor of botany and director of the Botanic Garden, University of Besançon, and a gold medallist of the French Geographical Society, aged seventy-eight years.

Prof. W. F. Shanks, professor of physiology in the University of Leeds since 1923, and formerly lecturer in physiology in the University of Glasgow.

Prof. V. A. Steklov, professor of mathematics at the University of Leningrad and vice-president of the U.S.S.R. Academy of Sciences, on May 30, aged sixty-one years.

News and Views.

SITTING in committee on the Finance Bill on June 21, the House of Commons rejected a clause moved by Mr. Withers (University of Cambridge) providing that a university, a college, or hall in a university, a public school, and any educational institution receiving a Government grant, should be exempt from income-tax in respect of any profits forming part of its income which were applicable to educational purposes only. The Chancellor of the Exchequer opposed the motion, though he stated that he was not satisfied with the present state of the law on the subject of the exemption of 'charities' exempt from income tax. The motion arose on the decision recently given by the House of Lords that a public school making a surplus is liable to taxation as earning profits, but the general question is closely related to the letter from the president and the treasurer of the Chemical Society which appeared in our issue of June 19 and their further letter in this present issue.

THOSE engineers who hold that the concentration and standardisation of electrical power supply in Great Britain is the best policy to adopt, and are weary of the somewhat fruitless discussions on points of administration taking place during the Committee stage of the present Government Bill, will now be able to point to the ever-growing electrification of Germany in support of their views. Plans have already been made for the inter-connexion of the existing power stations in Germany by overhead 'feeders' on a gigantic scale. In the past the production of electrical power in Germany has developed on individualistic lines. The largest power works belong to the Reich, which produces more than a thousand million units per annum solely for profit. There are very many stations, however, of much smaller size which are very uneconomical. In some cases they burn peat fuel, and supply only a few hundred consumers. Owing to the great distances involved, it will be necessary to use very high pressures, and experiments are proceeding with insulators for use on lines with transmission pressures of 220 and 380 kilovolts.

Two main schemes for electrification in Germany have been planned. The first proceeds from the water-power stations at the Vorarlberg in South Germany to Hamburg, and the second from the same source through the Central German lignite fields and Berlin to East Prussia. A length of about 100 kilometres from the Goldenbergwerk to the Wesel is now working at 110 kilovolts, but double this pressure will probably become the standard. As chains of insulators are used there is no difficulty about insulation. With these high pressures it is necessary to use overhead wires of large diameter, otherwise brush discharges—the so-called corona—appear on the wires and lead to a serious loss of power. The conductors therefore are generally made of aluminium and are hollow. Some of the cable manufacturers make the conductors of copper, the outer cylindrical shell being supported by a helix of copper tape wound inside the hollow. In California, 220-kilovolt transmission over 243 miles has been in successful operation for the last two years. The cables are of aluminium with a steel core and are supported by chains consisting of twelve insulators.

REPORTS have appeared recently in some of the newspapers of a new steel, described as 'F' steel, which was stated to have great advantages for structural

work, a saving of 40 per cent. in weight and 30 per cent. in cost as against ordinary mild steel being claimed. No particulars were given, but the manufacturers were said to be the Freund Smelting and Machine Manufacturing Co., of Berlin, the patent having been acquired from the Swiss metallurgist Bosshardt. A paper in *Stahl und Eisen* for April 15 gives a detailed account of the steel, from which it appears that Messrs. Freund were not in any way responsible for the newspaper statements. The steel is not a new one, but is a high-silicon alloy of a kind already known to metallurgists. Neither is the Bosshardt furnace essential to its manufacture, steel of similar properties having been made in ordinary steel furnaces. Messrs. Freund have allowed the particulars to be published, an investigation of its properties having been made by them in collaboration with the Verein deutscher Eisenhüttenleute. The steels examined contain from 0·67 to 1·1 per cent. of silicon, with low carbon, about 0·10 to 0·14. This gives an increased elastic limit and breaking strength as compared with simple carbon steel, whilst the ductility is not reduced. In the interesting volume of Sir Robert Hadfield on "Metallurgy and its Influence on Modern Progress" (see NATURE, February 6, p. 187) the use of a similar steel, but with a rather higher carbon content, in the construction of the *Mauretania* and *Lusitania* in 1907, is described. The introduction of these steels into shipbuilding was due to the late Mr. John Spencer, the composition having been arrived at as the result of the original investigations on silicon steels by Sir Robert Hadfield.

WHEN certain adhesive tapes such as are used for insulating purposes are unrolled, a bright greenish luminescence appears over the region of immediate separation occupied by the suddenly extended threads of the viscous adhesive medium. A letter on this subject entitled "Bioluminescence" was communicated by Dr. J. W. French to NATURE of June 20, 1925, p. 944, the title being suggested by the resemblance to the greenish light emitted by certain insects. Only a few kinds of insulating tape exhibit the phenomenon, such, for example, as the black "Chemico" British tape and the white Italian tape. According to Prof. Elmer O. Kraemer, of the University of Wisconsin, Madison, the light is produced when the adhesive tape is separated from the ends of the film proper in camera roll films. There are, however, many types of roll film that do not act in this way. It can be demonstrated that the effect is associated with particular adhesives and not with the film itself. Similar luminescence sometimes appears when the adhesive tape is stripped from the joint of the tin in which unexposed kinematograph film is usually contained. It occurs in the adhesive between the tape and the tin.

IN some further experiments Dr. French has found that excellent results are obtainable from the use of ordinary rubber vulcanising solution, provided it is in a suitable physical condition of tackiness, which may be varied by treatment with sulphur. The adhesive threads must not be too extensible: on the other hand they must not be too short or brittle, for if the experiment is repeated with the pieces of tape which in the first instance have produced a bright light, the luminosity will be fainter and the threads shorter. If the pieces, however, are kept pressed together for a day or two, the threads will be of more normal length and the light may be as strong as before. There thus seems to be some close connexion between the rate of extension up to the breaking point and the luminosity. Prof. Eligio Perucca, Laboratorio di Fisica Sperimentale della R. Scuola di Ingegneria, Torino, who in his lectures on experimental physics includes the phenomenon in question as a type of luminescence, states that, if one of the tapes is connected to a gold-leaf electroscope, it will be found that the stripping operation produces an electrostatic charge of three or four units at a pressure of about 200 volts. In his original communication, however, Dr. French stated that the light appears undiminished in brightness when the tapes are unrolled under water or in a Bunsen flame, so it can scarcely be assumed that the electric charge is the cause of the luminosity.

THE new Pharmacological Laboratories of the Pharmaceutical Society were opened by the Minister of Health, the Right Hon. A. Neville Chamberlain, on Wednesday, June 16. The chair was taken by Mr. P. F. Rowsell, immediate past president of the Society, during the tenure of whose presidency the opening ceremony should have been performed at the beginning of May. In his speech Mr. Rowsell referred to the passage into law of the Therapeutic Substances Act and the necessity which arose for the existence of a laboratory where those manufacturers who wished could have tested the products which were placed upon the schedule of the Act from time to time. Dr. J. H. Burn, Director of the Laboratories, described in more detail the functions which it is hoped the laboratories will subserve, and laid special emphasis upon the research into methods of standardisation which will be vigorously carried on in the future. He referred also to the international importance of the work which has been carried out since the War on this subject in the laboratories of the Medical Research Council under the direction of Dr. H. H. Dale, adding that it is gratifying to realise that Great Britain has taken the lead in introducing methods for the biological standardisation of drugs. Dr. Burn also mentioned a third reason for the founding of these Laboratories, namely, in order to afford an opportunity for the training of pharmacists in methods of biological standardisation. Mr. Chamberlain, in declaring the Laboratories open, referred to the many and varied duties of a Minister of Health, all questions relating to the prevention of disease as well as to the purity of the drugs used in treating it coming within his province. Sir Humphry Rolleston, moving a vote of thanks to Mr. Chamberlain, referred to the interest taken by the late Mr. Joseph Chamberlain in the health of the British possessions in the tropics. Mr. Edmund White, chairman of the Society's Scientific Advisory Committee, seconded the vote of thanks, and Mr. Chamberlain briefly replied. After the ceremony, the company adjourned to the Laboratories, where

Dr. Burn demonstrated methods used in the standardisation of the digitalis group of drugs, and of ergot and pituitary extract.

UNDER the will of the late Sir Winthrop Hackett, first Chancellor of the University of Western Australia, the sum of 50,000*l.* was left to the University and the Anglican Church. Three-eighths of the money was to be devoted to providing scholarships, three-eighths to be invested until it accumulated to 40,000*l.* when a Winthrop Memorial Hall was to be erected, and one-quarter was left for the purpose of the erection and maintenance of an Anglican University College with a chapel attached thereto. Not content with these proofs of his devotion to the University, Sir Winthrop bequeathed the balance of his residuary estate to the same two bodies in the same proportions and in the same manner. Sir Winthrop died in 1916, and the trustee of the estate, Mr. Alfred Langler, has informed the University Senate and the Diocesan Trustees that he will shortly have paid off all liabilities and all the numerous legacies with the exception of those of the University and the Anglican Church. The University and the Anglican Church, for the purposes of the trust alluded to in Sir Winthrop's will, are now the sole heirs of the very valuable estate left by Sir Winthrop Hackett. That estate includes the principal daily newspaper in Western Australia and a weekly paper, both of which have been flourishing for many years. The bequest is without doubt one of the most munificent that has ever been made to an Australian university. To Sir Winthrop Hackett is due in large measure the starting of the University of Western Australia, and it will be remembered that he, during his lifetime, endowed the chair of agriculture.

THE political significance of recent events in Poland is outside the scope of this journal, but the outcome, the election of Prof. Ignace Moscicki as the new President of Poland, is noteworthy in that Prof. Moscicki is a distinguished man of science who has also been actively concerned in industrial chemistry. We are indebted to the *Chemical Trade Journal* for some details of his career. Prof. Moscicki is best known for a process for the fixation of nitrogen by the arc method, which was elaborated while he was director of the electro-technical and electro-chemical laboratories at the University of Freiburg. In 1912 he was appointed to a similar post at the University of Lwow which he held until after the War. Since then he has been head of the Polish State Nitrogen factory at Chorzow, where the manufacture of cyanamide has been developed, the monthly output now reaching about 10,000 tons. For five years he was a student in London. Prof. Moscicki has a reputation as a scientific worker and as an administrator, and there is little doubt that the discipline of his early training will serve him well in his difficult task of guiding the fortunes of a modern European State.

A NUMBER of paintings on ivory by Winifred Brunton, with the collective title "Africa, Ancient and Modern," is now on view at the Arlington Galleries, 22 Old Bond Street. Mrs. Brunton, as those who visit this exhibition will appreciate, has devoted much time to the study of Egyptian antiquities from the artistic point of view, and is responsible for the beautiful coloured plates illustrating the "Portraits of the Kings of Egypt." In the collection now on view more than half the subjects are drawn from ancient Egypt. All show a wonderful and accurate sense of colour, which finds full play in the reproductions of personal ornaments, although "A Temple Vase" and the lotus cup from the Cairo Museum will bear comparison with any. Of the heads, "An Unknown King," reconstructed from a statue in the Cairo Museum, and "Amenemhat III." are remarkable conceptions of force of character. There are two very charming pictures of dancers, the "Wind in the Reeds" being especially pleasing in composition and colour. The paintings from South and East Africa include several subjects of ethnographic interest. The reconstruction of Rhodesian man is more convincing than some attempts that have been made to clothe this interesting relic with flesh. The exhibition was opened by Mr. Robert Mond on June 21 and will remain open until July 2.

COMMEMORATION DAY at Livingstone College, London, E.10, was celebrated on Wednesday, June 9. The Right Rev. the Lord Bishop of Chelmsford presided, and in the course of his address said that the College exists to help all missionary societies of the church and churches; that those who go forth may at least have some kind of knowledge both as to the management of their own health and of that of other people. Missionaries trained at the College are a tremendous help to the people to whom they go if one looks at it from only a humanitarian point of view. The Rev. B. T. Butcher, of the London Missionary Society, an old student of the College, referred to conditions in New Guinea. When he first went out there, there was but one cure for the loathsome disease of yaws, and in most cases it took more than a year to effect a cure; now it can be dealt with in a short course of treatment. In his opinion, yaws will be almost unknown round the coast of New Guinea in ten years' time, and Livingstone College will have played a part in making it unknown. Mr. R. L. Barclay, hon. treasurer of the College, referred to the work which had been done for the College by the late Dr. Harford, and stated that they had already received 770*l.* towards a fund of 3000*l.* which was being raised in his memory. The Principal of the College mentioned that old students are in Sierra Leone, Labrador, Siam, North Africa, and many other parts of the world; last year 103 students entered the College, including the short course and vacation course students.

IN the *Journal of the Franklin Institute* for May, Dr. C. E. K. Mees of the Eastman Kodak Company contributes an article on the colour sensitivity of photographic materials, in which he traces the subject from its very beginnings down to the present day, especially with regard to its practical aspects. Modern panchromatic plates and films enable exposures of one-fiftieth of a second to be given through

the tricolour red and green filters with apertures so low as $f/4{\cdot}5$, as is necessary in colour kinematography and in aerial photography with the red filters which have to be used to do away with the fogging effect of atmospheric haze. A very instructive diagram shows that in the period 1904–1919, photography of the spectrum was possible from a little over λ200 to a little beyond λ700; in 1919–1925 sensitiveness to the infra-red was extended to rather beyond λ800; while at the present time it is possible "easily" to photograph to rather beyond λ900, and "with difficulty" to photograph from practically λ100 or even λ50 to λ1000, the "difficulty" being the long exposure necessary, and the need for vacuum apparatus when using the shorter wave-lengths. The paper includes many interesting illustrations, one being of the planet Mars to show the difference between the results when an ordinary plate and when an extreme red-sensitive plate and filter are used. The latter shows detail that is invisible in the other, and shows the actual surface of the planet, while the ordinary plate shows a much larger disc due to the atmosphere that surrounds it. Dr. Mees finally refers to the work of Barnard and Gye on the cancer virus, who by using a wave-length of λ257 and a microscope with quartz lenses of numerical aperture 1·25 have obtained a resolving power of 0·11 μ instead of the visual resolving power obtainable of 0·2 or 0·16 according to the light used. It seems questionable whether there is any practical gain, especially considering the great difficulty of using the apparatus. "Barnard, however, is undoubtedly trying to get shorter wave-lengths."

THE forty-fifth annual meeting of the Society of Chemical Industry, which will be held in London during the week July 19–23, is to assume the character of a Congress of Chemists, and as such will be supported by a large number of societies connected with chemistry. On July 19, in the Mansion House, Lord Balfour will deliver the third Messel memorial lecture in the presence of the Duke of York and the Lord Mayor; earlier in the day Sir Frederic Nathan will give his presidential address to the Institution of Chemical Engineers on "Industrial Efficiency and the Elimination of Waste," and Sir Max Muspratt will open an exhibition of British chemical plant. With the exception of these two items, which will take place in the Central Hall, Westminster, and of an exhibition of chemical apparatus at the Institute of Chemistry, all the meetings and most of the social functions will be held in the Hotel Great Central, London, N.W.

THE scientific meetings in connexion with the forthcoming meeting of the Society of Chemical Industry will be open to chemists without restriction and will include discussions on corrosion, hormones, and "Chemistry House" (July 20); power alcohol, the influence of particle size in the paint and rubber industries, under the chairmanship of Sir William Bragg (July 22); fat-extraction by solvents, and solid smokeless fuel (July 23). Among the papers to be read, those on the experimental study and use of hormones, by Dr. H. H. Dale, and sugar from wood, by Dr. W. R. Ormandy, appear to be of exceptional interest. Addresses by Sir Josiah Stamp and Sir Max Muspratt are announced for July 21. There will be a large number of excursions and visits to works, and the many social functions will include a garden party in the Royal Botanic Gardens, by invitation of Sir Alfred and Lady Mond, the annual dinner of the Society of Chemical Industry, a smoking concert, dance, and conversazione. The Chemical Industry Club is offering honorary membership to all attending the Congress. Full particulars and tickets are to be obtained from the Society of Chemical Industry, at Central House, Finsbury Square, London, E.C.2.

SIR HUMPHRY ROLLESTON, Bart., Regius professor of physic in the University of Cambridge and lately president of the Royal College of Physicians, has been awarded the Gold Medal of the British Medical Association.

FURTHER details of Miss Garrod's discovery of a skull, presumably of Mousterian age, at Gibraltar, tend to confirm the first impressions of its importance. In addition to the frontal bone another large piece of bone was found, but owing to the hardness of the matrix in which it is imbedded it is impossible yet to say whether it is the parietal or the occipital. Decision on this and other points must wait until it has been cleared. The hardness of the matrix has by no means been entirely a drawback, as it has ensured the recovery of the fragments in pieces of considerable size.

IT is announced that the Medical Research Council, on behalf of the Rockefeller Foundation, has made the following awards of medical fellowships provided by the Foundation and tenable in the United States of America during the academic year 1926–27: Dr. G. Bourne, St. Bartholomew's Hospital, London; Mr. H. W. B. Cairns, London Hospital; Miss R. E. Lucas, Maudsley Hospital, London; Mr. R. D. Mackenzie, University of Edinburgh; Mr. C. F. A. Pantin, Marine Biological Laboratory, Plymouth; Dr. A. F. B. Shaw, University of Durham; Dr. J. C. Spence, Royal Victoria Infirmary, Newcastle-on-Tyne; Mr. H. E. C. Wilson, University of Glasgow.

THE research steamship *William Scoresby* is now being fitted out at the Humber Dock, Hull, and is expected to be ready for sea at an early date. She is a small vessel of the whale catcher type, her principal dimensions being: length, 125 ft.; breadth, 26 ft.; depth, 14½ ft.; draught, 13½ ft. The *William Scoresby* will be employed, in conjunction with the R.R.S. *Discovery*, and will operate principally in tropical and antarctic regions. Her duties will consist generally in the marking of whales, steam trawling and other marine biological investigations. The ship's company will include two scientific workers, the master, four officers, and fourteen petty officers and men. The whole cost of the vessel will be met from the funds of the *Discovery* Expedition which are derived from the revenues of the Falkland Islands Dependencies.

THE part enacted by the house-fly as a carrier of disease organisms and the necessity for efficient

measures preventing the breeding of this insect are facts of prime importance from the point of view of public health. We therefore welcome the appearance of a second edition of the illustrated brochure on this insect which has been recently issued by the British Museum (Natural History). The author, Major E. E. Austen, has revised and expanded the text of the first edition and has brought the pamphlet thoroughly up-to-date. Its full title, "The House-Fly, its Life-History, Importance as a Disease Carrier, and Practical Measures for its Suppression," sufficiently explains its scope. It may also be added that the author deals with the insect under other conditions besides those met with in the British Isles, and has incorporated the results of experience gained through the operation of sanitary measures in the War. The pamphlet is obtainable either from the Natural History Museum, South Kensington, or through booksellers, price 1*s*.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A demonstrator in the Department of Inorganic and Physical Chemistry, Bedford College for Women—Secretary, Bedford College, Regent's Park, N.W.1 (July 3). Part-time lecturer in sociology, Bedford College for Women—Secretary, Bedford College, Regent's Park, N.W.1 (July 3). Research chemists for the Fuel Research Station, East Greenwich—Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (July 3). Analysts for work in connexion with the Physical and Chemical Survey of the National Coal Resources of Great Britain—Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (July 3). Half-time assistant in the Department of Mathematics, University College of Swansea—Registrar, University College, Swansea (July 9). Two junior scientific officers at the Royal Aircraft Establishment—Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (July 10). Assistant lecturer in physics, University College of Wales—Secretary, University College, Aberystwyth (July 13). Lectureship in chemistry in the University of Durham—Registrar, Armstrong College, Newcastle-upon-Tyne (July 17). Assistant agricultural chemist in the Department of Science and Agriculture, Barbados—Secretary (Appointments), Colonial Office, 38 Old Queen Street, S.W.1 (July 31). Senior laboratory assistant in the Department of Entomology, London School of Hygiene and Tropical Medicine—Secretary of the School, 23 Endsleigh Gardens, W.C.1 (July 31). Head of the Chemistry Department, Borough Polytechnic Institute—Principal, Borough Polytechnic Institute, Borough Road, S.E.1. Several inspectors of agriculture for the Sudan Government—Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1.

Our Astronomical Column.

RECENT SOLAR ACTIVITY.—For several weeks there has been an absence of very large sunspots, although smaller ones, averaging half-a-dozen daily, have been of interest to observers with moderate telescopic means. In addition, faculæ at both limbs of the sun have been present on most days, some of the areas being of considerable extent. Traces of the faculæ related to the great spot of last December and January in north latitude 22° were seen about a fortnight ago. On June 21, a group of spots, the development of which had been watched since June 16, was of sufficient size to be a naked-eye object on the disc. The group consisted of a roughly circular spot as leader closely followed by a close cluster of small spots, which on some days linked up with one another to form a composite companion to the leader. On June 15, Mr. Newbegin, observing with his spectroscope at Sutton, Surrey, noted a metallic prominence (that is, one having a spectrum containing metallic lines) at position angle 63°, which corresponds almost exactly with the position of the newly forming spots then at the sun's east limb. This prominence, of the 'rocket' or 'splash' type, appeared as if the gases were being expelled from a common centre. Such prominences, according to Evershed and other observers, are very frequently found connected with sunspots, either during their active development, or at other times when great changes are taking place.

Particulars of the large spot are given below :

No.	Date on Disc.	Central Meridian Passage.	Latitude.	Area.
7	June 16-(28)	June 22·0	25° N.	1/1400

(Area expresses the proportion covered of the sun's hemisphere.)

NEPTUNE'S SATELLITE.—Prof. Eichelberger's and Mr. Arthur Newton's exhaustive researches on this satellite have already been mentioned in NATURE. Their paper is printed in the March issue of *Mon. Not. Roy. Ast. Soc.*, and deserves a further note. It is curious that though no certain markings have been seen on Neptune's surface, we now know the position of its axis nearly as accurately as that of Mars. The position of its north pole is given as R.A. 295°·2, N. Decl. 41°·3 (equinox 1900·0) : the pole of the satellite's orbit describes a circle of radius 20°·1 in 585 years, the annual motion being 0°·62. The observations indicate a considerably greater motion for the major axis of the satellite's orbit, from 1°·5 to 3°·0 per annum. It moves in the opposite direction to the node, as it should, but the observed motion is probably too great. Owing to the very small eccentricity, about 0·005, it is very much more difficult to determine the position of the apse than of the node. Dr. J. Jackson deduces 1/66 and 19 hours as the probable values of the compression and rotation period of Neptune.

TEMPERATURE OF MARS.—*Astr. Nach.* No. 5448 contains an article by W. W. Coblentz comparing the measures made by Lampland and himself at the Lowell Observatory with those made by Pettit and Nicholson (100-inch at Mt. Wilson). It is noted that the receiver used by the latter covers a Martian area 50 per cent. larger than that used by the former ; this would make the measures more nearly average ones for the whole surface, and less affected by the particular regions in view. The measures show that dark areas are hotter than bright, and that the afternoon side of the planet is hotter than the morning side ; the latter point is not so plainly indicated in the measures of Pettit and Nicholson, but terrestrial analogy makes it reasonable. Radiation near the east and west limbs was found to be respectively one-third and one-half of that at the centre. The article closes with a note of satisfaction that the two sets of observations are on the whole accordant.

Research Items.

ENGLISH GYPSY FOLK MEDICINES.—Mr. T. W. Thompson, in the *Journal of the Gypsy Lore Society* (Ser. 3, Vol. 4, Pt. 4), publishes some notes on the remedies used by gypsies for both human beings and horses, which are of some interest in view of the reputation which this people has long held for their skill in the art of healing. The information was obtained mainly from members of the Smith and Boswell families. Generally speaking, medicines made from herbs are preferred, and the list given includes forty-seven wild plants held to be efficacious for various diseases. Among them are hemlock and foxglove, which were recognised as dangerous plants, as also were monkshood and nightshade, and only used in weak infusions. Of the fungi, those growing in woodlands were regarded with suspicion, but of those growing in the open several varieties were sometimes eaten. One informant had a preference for simples; another preferred a number of ingredients. Though some of the herbal remedies can be justified in the light of modern knowledge, others rest on the doctrine of signatures which attested that plants and minerals indicated by their external characteristics the diseases for which Nature intended them as remedies. This applied also to the animal kingdom, *e.g.* hedgehog's fat was used for earache or a slight deafness, the skin of a supple eel for stiff joints. Other remedies provide examples of a symbolic transference or rebirth. For asthma the sufferer caught a trout alive, breathed three times into its mouth and put it back into the water. A spider was hung in a bag around the neck of a sufferer from ague, and as the spider died the ague left him. Hair from the cross on a donkey's back, skeleton feet of hedgehogs and moles, pieces of red cotton and wool are among the prophylactics against various diseases.

CALIFORNIAN ARCHÆOLOGY.—The results of an examination of relics of the Indian tribes formerly inhabiting the Southern San Joaquin Valley, California, by E. W. Gifford and E. Egbert Schenck, have been published as Pt. 1 of vol. 23 of the *University of California Publications in American Archæology and Ethnology*. The geographical features of the Valley which have determined the character and extent of human occupation have been the lakes Tulare and Buena Vista. The general aridity of the valley and the variable water level which, at any rate in Tulare, ranges from 220 feet to absolute dryness, not only determined the site of occupation, but also in all probability prevented any very extensive or dense occupation. Presence of the Spaniards in other areas added fugitives to the population, and this and other causes have effected an extensive mixture of race and culture. The relics obtained from surface finds and excavation of burial- and camp-sites represent a great variety of artefacts, of bone and horn, steatite, chipped stone, ground stone, unworked stone, textiles and cordage, pottery and wood. Forty human crania were obtained which belonged to two types: the San Joaquin sub-type of the Californian type, short-faced and broad-nosed, and the Buena Vista type, relatively long-faced and narrow-nosed. The southern part of the San Joaquin Valley lies in an area the cultures of which have not yet been described. There is a generic resemblance between the culture of the San Joaquin area and the Santa Barbara area, but the two centres of the San Joaquin Valley, the Alpaugh and the Lake regions, have certain points of resemblance to the Santa Barbara culture which are mutually exclusive. This suggests independent lines of transmission, the Alpaugh possibly representing an earlier phase of the Santa Barbara culture. Certain features, such as the bags, the ceremonial use of human hair cordage, and of ground crescentic stones for girls' puberty ceremonies, point to Southern California.

INTESTINAL PARASITES OF RUMINANTS.—M. J. Triffitt records (*Protozoology*, No. 2, Jan. 1926) the results of examining the fæces of certain ruminants in the London Zoo. She found in the sable antelope from South Africa, and in a pair of common waterbuck from East Africa, an Entamœba which closely resembles and is probably specifically identical with *E. ovis*. Both active forms and cysts were present. Uninucleate cysts of some hitherto undescribed species of Entamœba are recorded from the fæces of an eland. The author also describes sporozoan parasites found in the intestinal wall of Bennett's wallaby. Two of these are closely allied to or identical with *Ileocystis macropodis* and *Lymphocystis macropodis* respectively, which the author considers should be ranged under the genus Globidium. One of the other parasites is an Eimeria (*E. macropodis*), the various stages of which are described.

FLAGELLATES IN THE LATEX OF ASCLEPIAS.—*Herpetomonas elmassiani* is the only species of latex-inhabiting herpetomonad in the United States, and it has been found in great numbers in the common milkweed, *Asclepias syriaca*, in Maryland and New Jersey. Further studies on the relations of the flagellate to its plant host have been carried on by F. O. Holmes (*Biol. Bull.*, 49, 1925). He shows that the flagellate is confined to the latex system and that the Herpetomonas is intracellular but not intracytoplasmic. The latex is secreted into the general cell vacuole of the latex duct and it is in this that the flagellates occur. No other cells were found to be infected. A red and black hemipterous insect, *Oncopeltus fasciatus*, is suspected of being the insect host of *H. elmassiani*, and the flagellates were found in the trilobed salivary glands of this insect, chiefly lining the lumen of the dorsal lobe; a few were present in the anterior lobe, but none in the ventral lobe. Search for the flagellates in the intestine of the insect gave negative results.

TIDAL DATA FOR THE ANTARCTIC.—A reprint has reached us of the reduction by Dr. A. T. Doodson, The Tidal Institute, University of Liverpool, of the tide gauge records made at Cape Evans, in the Antarctic, by Mr. Nelson during 1921–22 (June-January). The reprint appears to be an excerpt from a volume collecting the results of the expedition, but bears no indication of its origin and gives no mention even of the name of the expedition. This was the third expedition wintering on Ross Island, and comparison is made of the amplitudes and phases of the principal tidal constituents (S_2, M_2, K_1, O_1) derived from the three expeditions, the others being those of the *Discovery* (1902) and the *Nimrod* (1907), all of which had their stations within a few miles of one another. The three sets of results are in very satisfactory agreement, and the tides in this small region of the Antarctic may be considered adequately known.

HYDROGRAPHICAL CONDITIONS IN THE BALTIC.—A survey of the hydrographical conditions in the northern part of the Baltic has been carried out during the summers of 1922, 1923, and 1924 by Finland and

Sweden working in co-operation, the region at the entrance to the Gulf of Bothnia having received the greatest attention. The results are recorded in the following publications recently received: Havsforskningsinstitutets Skrift. No. 30: *Thalassologische Beobachtungen im Ålands- und Schärenmeer im Juli 1922 und Juli 1923*. Herausgegeben von Rolf Witting und Hans Pettersson. Pp. 39. 7 Fmk. No. 32: *Talassologiska vårexpeditionen 1924. Referat: Die thalassologische Terminfahrt im Jahre 1924*. Av Risto Jurwa. Pp. 27. 4 Fmk. No. 34: *Regelmässige Beobachtungen von Temperatur und Salzgehalt des Meeres im Jahre 1923*. Von Gunnar Granquist. Pp. 54. 10 Fmk. No. 36: *Dagliga vattenståndsuppgifter 1923. Referat: Tägliche Wasserstandsangaben 1923*. Av Henrik Renquist. Pp. 46. 8 Fmk. (Helsingfors: Statsrådets Tryckeri, 1925.) Continuous measurements for several days were made by means of current meters at a number of positions where the physical conditions of the water, including the rate of evaporation and the change in water level, together with the meteorological conditions, were also observed. Currents of $\frac{1}{4}$ to $\frac{1}{2}$ mile per hour were met with in the neighbourhood of the Aland Isles, running usually northward into the gulf and apparently not dependent upon the winds during the period of the survey. A south-going stream ran along the Swedish shore. No conclusions are drawn from the numerous data and no review of the conditions met with are included in the published records.

THE BATH SPRINGS.—Dr. R. H. Rastall in the *Geol. Mag.* for March 1926 reprints his interesting article on the geology of the Bath springs from "The Book of Bath," 1925. The temperature of the waters is about 70° F. above that of normal spring water, indicating that the ultimate source must be at least 5000 feet below the surface. This deduction, and the saline character and radioactivity, lead to the conclusion that the Bath and similar thermal springs in other countries are fed by deep-seated sources of igneous origin. The uprise of such waters involves the existence of pronounced fractures, and in the case of Bath it is not difficult to account for the existence of suitable fractures. The east and west lines of folding and fracture of the highly disturbed Mendip region and the similar north and south lines of the Malvern disturbances cross in the neighbourhood of Bath, thus producing lines of particularly easy penetration through the older rocks. The fractures, however, were produced before the Triassic and Jurassic beds were deposited, and the clays of the latter system seal up the water to some extent. Borings which have passed through the Rhætic clays encountered red sands from which hot water flowed. Thus the exact points of outflow at the present surface must be determined by the presence of small faults or fissures of later origin in the clays which underlie the city itself.

THE ANGLES OF CRYSTALS DURING GROWTH.—Miers has suggested that the formation of vicinal faces in crystals is due to the difference in the density of packing of the molecules in a crystal and those in a saturated solution. Further, it is considered that owing to the greater density of packing of the former the molecules of the solute separating from the solution find difficulty in compressing themselves into the closer packing of a simple crystal face. Experiments by E. S. Hedges described in the *Journal of the Chemical Society* for April 1926 support this view. By very slow growth of a crystal of sodium chlorate, single perfect cube faces have been obtained, since under such conditions the solute molecules can more easily take up their correct positions in the crystal face.

MAGNESIUM ELECTRODES IN SPECTRAL ANALYSIS.—The advantage of magnesium electrodes in cases where only small amounts of the material to be investigated are available are described by M. E. Dureuil in the *C. R. Acad. Sci.*, Paris, of April 26. Cylinders 1 cm. in diameter were employed as electrodes, the substance to be examined being placed in a cavity of about 1 mm. diameter in the positive electrode. They can be used either for arc or for spark spectra; in the former case the current should not exceed 1 ampere, to avoid ignition of the magnesium. The spectrum of magnesium is a simple one, with only about fifty lines, and in the region between 7000 and 3500 Å.U. there are only about ten strong lines; these do not come in the way of the characteristic lines of the other elements. Even with commercial magnesium the lines due to the impurities copper, iron, manganese, silicon, calcium, sodium, aluminium and carbon are weak, and would only cause difficulty in cases where these elements have to be investigated. The use of these electrodes has been found particularly valuable in the case of the platimum metals, the alkalis and alkaline earths, and especially for non-conducting minerals which resist the action of fused carbonates. This is probably due to the strong reducing action of magnesium, which at the high temperature of the arc or spark displaces the metals from their compounds, so that they give their dissociation spectra in the most favourable conditions.

THE ELECTRONIC STRUCTURE OF THE BENZENE MOLECULE.—In the *Journal of the American Chemical Society* for May 1926, L. Pauling discusses the electron-orbit-sharing theory of chemical bonds in connexion with the electronic structure of the benzene molecule. The carbon and hydrogen atoms are in the same plane at the corners of two concentric regular hexagons, and the manner in which they are connected by the shared bonds is described. Pauling extends this theory to naphthalene and anthracene, and shows that it accounts for the properties of these substances.

VITAMINS IN HEAT-STERILISED FOODS.—In view of the lack of direct evidence on the vitamin content of foods sterilised by heat and the conflicting results of earlier workers, C. M. Dugdale and R. J. Munroe have started a number of experiments on this subject. The first of the series, described in the *Journal of the Society of Chemical Industry* of May 21, deals with the presence of vitamins in meat preparations and shows, in the form of curves, the effects of various samples on the growth of rats reared on a vitamin-free diet. It is concluded that meat has a higher vitamin value than is usually supposed, and the heat processes used to sterilise it on a commercial scale affect the vitamins only slightly.

THE REACTION BETWEEN ETHYLENE AND CHLORINE.—Norrish studied the reaction between ethylene and bromine in a glass vessel and in glass vessels covered with wax, cetyl alcohol and stearic acid, and concluded that the reaction took place on the glass but not on the paraffined surface. Stewart and Edlund found that the reaction was of the second order, taking place entirely on the walls of the glass vessel containing the mixture. In the *Journal of the American Chemical Society* for May 1926, Stewart and Fowler describe the reaction between ethylene and chlorine in the presence of dry air. They state that this is also a second-order reaction taking place at the glass surface at approximately one-tenth of the speed the reaction between ethylene and bromine.

South-Eastern Union of Scientific Societies.

THE thirty-first annual Congress of the South-Eastern Union was held at Colchester on June 9-12, under the presidency of Mr. Reginald A. Smith, of the British Museum, in succession to Sir John Russell, director of the Rothamsted Experimental Station. In his address Mr. Smith dealt with "Essex in pre-Saxon Times," and pointed out that Essex is particularly rich in remains of the Early Iron Age, or Hallstadt period. Before the arrival of the Romans, Colchester was the capital of the most advanced of the British tribes. With the aid of the lantern, phases of pre-Saxon civilisation were illustrated. The gradual degradation of the British gold coin, founded on the Macedon stater, was shown, and the introduction of that on which there came to be shown an ear of corn, the origin of which still remains a mystery. A point of interest dealt with was the origin of the Red Hills, so called, although they are but raised platforms of burnt earth. The president's view was that they are the débris from the preparation of the ground for the construction of salt-works, the base of the pans with its growth of vegetation being burnt over, and the material then being scraped together and deposited in such a way as to form platforms, which may have been used as refuges by workers against sudden irruption of the tide. Workers were invited to inquire as to the finding of currency bars of iron, as at present none have been found in Essex.

Mr. Chas. E. Benham contributed a paper in which he dealt with "Colchester's greatest Citizen," Dr. William Gilbert, whose monumental work "De magnete," founded on actual experiment, laid the foundations of inductive science. He showed thus early that the earth is a magnet, and that the phenomena of the compass with its varying dip and declination all conform to that principle. Gilbert's terellæ and his other early instruments were bequeathed to the College of Surgeons, but they were all unfortunately destroyed in the great fire of 1666. The arms of the borough of Colchester constitute a story in themselves, and are associated with the legendary story of St. Helen. King Cole reigned at Colchester at the end of the third century, and was her father. He was the merry King Cole of the nursery rhyme. On his coming to terms with the Roman general Constantius, he gave the general his accomplished daughter Helena in marriage. The story is recorded in the ancient records of Colchester, which date from about 1350, so that historic accuracy cannot be claimed for it.

Dr. E. J. Salisbury's paper on "Plant Communities of the Seashore" was of special interest in view of the proximity of the town to wide stretches of estuarine flats, and an excursion to Mersea Island and the Strood enabled botanists to examine and collect specimens of the flora dealt with by Dr. Salisbury. The Strood is interesting as being a causeway of Roman foundation, connecting the island with the mainland. In the Pyefleet, running north from the Strood, are the chief oyster-beds belonging to the Colchester Corporation, and here as elsewhere constant warfare is being waged against the slipper-limpet, specimens of which were collected along the coast when a geological ramble was made to the cliffs at Walton-on-the-Naze. Tons of the slipper-limpet are annually dredged up by the corporation dredgers and destroyed, but the pest continues to increase.

No other town, said Dr. Mortimer Wheeler, possesses a local museum surpassing that of Colchester as a collection of Roman antiquities. He spoke in the great quadrangle of the castle, and described Camulodunum (Colchester) as the royal seat of the Trinobantes under the king Cunobelinus. It was evident that the tribal community endeavoured to assimilate Roman culture and fashions. It was the intention of the Romans to make Colchester the capital of Britain, an intention that was afterwards frustrated by geographical and other considerations. The Balkerne Gateway was the largest gateway erected by the Romans in Britain.

A paper by Mr. E. C. Stuart-Baker dealt with "Some Curious Aspects of Evolution" in bird-life and was illustrated by excellent lantern slides. Examples were given among the pheasants and other birds of the direct effect of environment on variations. One of the best-known and most widely accepted factors in evolution is the atmospheric condition of humidity. Excessive humidity acts upon the pelage or plumage and causes great darkness or brilliant colouring. A moderate amount of humidity generally results in a dull neutral tint, dark or pale in proportion to the amount of humidity being above or below normal. The absence of all humidity causes white or very pale coloration. The lecturer asked his audience to remember that when they were told that the various forms of pheasants shown can be produced in captivity by hybridisation, environment no longer exists in captivity, and man, by the selection of suitable individuals for the creation of the form which he desires to reproduce, takes upon himself the privileges and powers of environment.

Mr. Hazzledine Warren's paper on "The Correlation of the Lower Palæolithic" gave rise to considerable discussion, in view of the opinions which he expressed as to the age of Strepyan implements, and the distinctive characteristics and duration of Chellean and Acheulian cultures. In Mr. Edward A. Martin's paper on "Break-names in Geological History," he showed that while doubt exists as to the proper correlation for passage-beds, bone-beds and newly discovered strata, it would meet a want if names were allotted to the breaks between the recognised systems, to which such strata could be allocated at least tentatively. These names he proceeded to allot, all of which would be derived from the names of geologists, examples being 'Lapworthian' for the break between Ordivician and Silurian, and 'Whitakerian' for the break between Cretaceous and Eocene. These names would at once be recognisable from those of systems, since they are all personal names. In the discussion that followed, it was agreed that the subject deserved the attention of geologists.

In a paper by Mr. J. H. Owen, of Felsted, which was illustrated by very fine photographs by the author, the matter of the cuckoo and its foster-parents was dealt with in a masterly manner, and it was shown that the young cuckoo made use of its rump and tail rather than its back for the ejection of young birds and eggs from the nest. It would climb up backward the side of the nest, with the youngster on its back, and then by a final flick of its rump eject the unwanted one.

Regional survey subjects were dealt with by Mr. Alexander Farquharson on "The Social Constitution of a County"; by Mr. Geoffrey E. Hutchings on "The Choice of Maps for Regional Surveys."

In connexion with the Congress a volume has been published entitled "Essex: an Outline Scientific Survey," a concise statement of scientific research in the county, written by members of the Essex Field Club and others.

Mechanism of Oxidation in Living Tissues.

THE isolation of glutathione by F. G. Hopkins in 1921 threw a fresh light on the processes of oxidation and reduction in living tissues, since the compound appeared to be of a simple constitution and not an enzyme, to which class of bodies the substances producing oxidation in the living organism were, in the majority of cases, considered to belong. Since then its constitution as a dipeptide of cysteine and glutaminic acid has been definitely proved, especially by its synthesis by Stewart and Tunnicliffe. It owes its activity in promoting oxidations to its property of acting either as a hydrogen donator, when it is present in the reduced (or cysteine) form, or as a hydrogen acceptor, when it is in the oxidised (or cystine) form: which form is present, depends on the conditions of its environment. Further details of its activity in promoting oxidations have recently been given by its original discoverer (F. G. Hopkins, *Biochem. Journ.*, 1925, vol. 19, p. 787). The paper deals with the oxidation of fats and proteins; at present the relationship, if any, between glutathione and carbohydrate utilisation has not been worked out.

Unsaturated fatty acids such as linoleic and linolenic are oxidised in the presence of the reduced form of glutathione (GSH), but the actual mechanism appears to be somewhat different at different hydrogen ion concentrations. At *p*H 3·0-4·0 large amounts of oxygen are taken up by the system: presumably a peroxide is formed by two thiol groups and the oxygen then passed on to the fatty acid, so that the reaction is catalysed by the GSH; it may be represented by the equation

$$AO_2 + 2B \longrightarrow A + 2BO,$$

where A = GSH and B = the fatty acid. On the other hand, at *p*H 7·4-7·6 less oxygen is taken up; in fact it is found that the amount is almost exactly twice that necessary to oxidise the GSH to the oxidised form (G_2S_2); in other words, the oxidation is a coupled reaction, according to the equation

$$AO_2 + B \longrightarrow AO + BO.$$

When the behaviour of the glycerides of the unsaturated fatty acids in the form of pure linseed oil was studied, different results were obtained. At *p*H 3·5-4·0 a latent period occurs before the oxygen uptake sets in; at *p*H 7·4-7·6 the equipartition of oxygen between GSH and the fatty acid is not seen, but after a high initial uptake the oxygen consumption falls off to a steady linear rate until nearly all the fat is oxidised. The point of inflexion on the curve corresponds to the time when nearly all the GSH has been oxidised, and unless there is a certain definite concentration of GSH present at the commencement, the oxidising system fails to become established. The cause of these variations is not yet known, but the establishment of the oxidising system in alkaline emulsions of linseed oil does not appear to be due to the presence of minute traces of iron.

For the investigation of the oxidation of the proteins the author has utilised certain pure preparations as well as a muscle powder obtained from the tissue by extraction with boiling water, and with alcohol and ether to remove lipoids, followed by drying and powdering. Such a muscle preparation in Ringer's solution at *p*H 7·6 and in the presence of oxidised glutathione (G_2S_2) takes up oxygen to the extent of 2000 c.mm. per gm. This oxidation occurs only in a solution of an alkaline reaction, and only when the protein is present as a solid phase, and also gives a positive nitroprusside reaction; that is, when it itself contains an – SH group. This 'fixed' – SH group of the protein is not oxidised by molecular oxygen, but can be by G_2S_2 even in the absence of oxygen. In this case the surrounding solution acquires a positive nitroprusside reaction owing to the reduction of the G_2S_2. The fixed – SH can be restored by contact with GSH; but it is not removed by simple washing of the tissue, nor is it a question of the adsorption of GSH to the tissue, but the fixed – SH appears itself to undergo alternate oxidation and reduction according to the conditions of its environment. It is probably the only reducing factor in the thermostable muscle residue.

It is to be noted that the amount of oxygen necessary to oxidise this fixed – SH group is only one-tenth of that taken up by the system in the presence of G_2S_2. Moreover, when the uptake of oxygen has ceased, restoration of the group by exposure of the powder to GSH will enable a further quantity of oxygen to be taken up with further oxidation of the protein: up to the present, an amount of oxygen equalling 10·0 c.c. per gm. of powder has been observed to be taken up, by renewing the fixed – SH group at intervals, and even this is not a maximum.

Pure proteins are not so active as the muscle powder. It is of interest to note that a protein which gives no nitroprusside reaction may be caused to react positively by denaturation. If GSH is added to the protein instead of G_2S_2, the initial oxygen uptake is quicker and the total oxygen uptake is greater by an amount which is nearly equal to that which would be required to oxidise all the GSH to G_2S_2; so that in both cases the oxidation of the protein proceeds with only minute amounts of – SH in solution.

To sum up, the oxidation of fat and protein depends on the hydrogen-ion concentration of the solution and on the fact that GSH is oxidised quickly in an alkaline, but only slowly in an acid, medium. At *p*H 7·6 protein alone is oxidised, and since GSH is quickly oxidised to G_2S_2, the fixed – SH of the protein molecule must be intact to ensure the presence of – SH in the solution. At *p*H 6·0 both protein and fat are oxidised, the latter owing to the fact that the GSH is maintained at a higher concentration in the more acid solution. At *p*H 3·8 fat alone is oxidised; and the process is slower in the presence of G_2S_2, since its reduction to GSH is slow.

The question has been examined from a different point of view by J. H. Quastel (*Biochem. Journ.*, 1926, vol. 20, p. 166). Investigating the dehydrogenations produced by resting bacteria, he was struck by the great variety of substances which were capable of acting as donators or acceptors of hydrogen: moreover, closely related compounds behaved differently in the presence of *B. coli* and methylene blue; one might be oxidised and the other not. It seems scarcely possible that the organisms possess enzymes capable of acting on each different compound; on the other hand, there is good evidence that the change in the molecule of a compound which enables it to undergo oxidation or reduction takes place at the outer surface of each organism, though possibly in some cases at a surface in the interior of the cell.

Recent work has shown that molecules are orientated in a surface, so that it may be considered as a mosaic composed of the different molecules arranged singly or in groups in a definite pattern, which is characteristic for each cell, but varies slightly with its growth and activity. This molecular arrangement will lead to the existence of varying

electric fields scattered over the surface of the cell, and the author considers that a molecule is 'activated,' and so becomes susceptible to oxidation (or reduction), when it comes under the influence of one of these electric fields, which causes a shift of electrons from one atom to another of the molecule. Thus the group $-CH=CH-$ becomes $-\overset{\vee}{C}-CH_2-$. The movement of the proton will be determined both by the shift of the electrons and also by the electrical condition of the molecule itself. Thus if a radicle is one electron short of its full number it will, replacing an atom of hydrogen in the molecule, turn its positive end towards the carbon atom with which it combines, and so tend to repel a positive charge. The opposite effect occurs if the replacing radicle has one electron more than its full complement. $-OH$, $-NH_2$, and $-CH_2COOH$ repel positive electricity, whilst $-COOH$, $-CONH_2$, and $-COCH_3$ attract it. Thus on activation, $R-CH=CH-COOH$ becomes $R-\overset{\vee}{C}-CH_2-COOH$, and $R-CH=CH-CH_2-COOH$, $R-CH_2-\overset{\vee}{C}-CH_2-COOH$.

The theory therefore offers a possible explanation of the well-known β-oxidation of fatty acids in living animals. The author has examined a large number of compounds in the light of his theory and finds that his experimental results can all be explained by it. It offers a satisfactory reason why closely related compounds should differ in their behaviour as hydrogen donators in the presence of resting organisms, and obviates the necessity of postulating the existence of large numbers of enzymes which have never yet been extracted from these cells.

The author considers it probable that the $-SH$ group, as it exists in glutathione, is one of the means whereby oxygen is activated so that it becomes a hydrogen acceptor. In other cases this may be due to small traces of iron or to the development of a peroxide at an activated carbon atom; *e.g.* $-\overset{\vee}{C}-X$ becomes $-\overset{O-O}{\underset{\vee}{C}}-X$, so that the process which activates the hydrogen donator may result at the same time in the activation of oxygen.

The Royal Society Conversazione.

THE Royal Society usually holds two conversaziones annually. The first of these gatherings was cancelled owing to the general strike, and the second was held on June 16 last. Many of the exhibits arranged in the Society's rooms have already been referred to in our columns. Limitations of space forbid more than passing notice of some of the remainder.

The Department of Entomology, British Museum (Natural History) (Mr. F. W. Edwards and Dr. P. A. Buxton) exhibited specimens of a submarine Chironomid. This is the first insect species known to spend its whole life in the sea, and was discovered by Dr. P. A. Buxton in Samoa, where it was found associated with other Chironomid flies having normal air-living adults. Mr. T. S. P. Strangeways and Dr. H. B. Fell showed microscope preparation of the development *in vitro* of the isolated eye of the embryonic fowl. Fowl embryos of 64-70 hours' incubation were used. An eye is dissected out and explanted into a medium composed of fowl plasma and embryonic tissue extract; here it grows and differentiates in a surprisingly normal way.

The Soil Physics Department, Rothamsted Experimental Station (Dr. B. A. Keen and Dr. W. B. Haines), exhibited a new combination of apparatus for measuring soil resistance which has marked advantages over the usual type of dynamometer. It is light and portable, and gives a continuous record of the draught, and a time scale, on a celluloid strip, which has great advantages over paper for outdoor work under varied weather conditions.

Lieut.-Col. F. J. M. Stratton and Mr. C. R. Davidson showed a number of photographs of the solar eclipse of January 14 last, taken at the expedition sent to Benkulen, Sumatra. The expedition obtained good photographs of the corona, the spectrum of the chromosphere, and also of the corona both with slit spectroscope and prismatic cameras, from a discussion of which it is hoped that fresh knowledge may be gathered as to the condition and constitution of the solar atmosphere. From the spectrograms of the corona it will be possible to obtain accurate wavelength measurements of the lines of the coronal spectrum of unknown origin.

Prof. O. W. Richardson showed an apparatus for the investigation of soft X-rays which are produced by the electronic bombardment of solids. The tube is of transparent silica, and is exhausted to a pressure of about one ten-millionth of a millimetre of mercury. The presence of the X-radiation is demonstrated by the photoelectric emission which it produces from a copper-plate enclosed in the tube.

The National Physical Laboratory had two interesting exhibits. The vector colorimeter (Mr. Guild and Dr. Perfect) enables a colour to be specified by *qualitative* measurements involving colour matches only. Two colour matches are made. In one the test colour is matched by a mixture of spectrum red with monochromatic light of suitable wave-length; in the other by a mixture of spectrum blue with another suitable monochromatic constituent. These matches determine the two vectors, and their intersection determined the position of the colour on the colour chart. A modified manometer for the determination of the vapour tensions of molten cadmium and zinc was also shown (Mr. C. H. M. Jenkins). This is measured by the pressure of nitrogen required to level the two liquid surfaces of the metal of a specially shaped manometer. The closed end of the manometer can be flooded by rotation of the apparatus, and foreign gases can also be removed by a similar rotation accompanied by a reduction of pressure.

Mr. W. M. Mordey showed some experiments demonstrating the possibility of getting a powerful rotation, in multiphase alternate current fields, of magnetic materials which are either non-conducting in themselves or are made so by being reduced to fine powder and then made up into solid discs or cylinders with some binding material, such as glue or shellac, which insulates the particles from one another. Such discs or cylinders, which form miniature induction rotors without windings and with non-conducting cores, can be made up of powdered magnetic materials such as hard cast-iron dust, hard steel grit, nickel, cobalt, and of the magnetic minerals magnetite and pyrrhotite; in such bodies no appreciable eddy currents are produced, the rotation being due entirely to hysteresis. An interesting item in the exhibit was a small alternate-current electric fan, the rotor of which consisted simply of a piece of pyrrhotite rock with no winding on it, revolving freely in the field of a small model multiphase magnet. Loose powders of any of these materials rotated in such multiphase fields in a direction opposite to that in

which solid masses of the same materials rotate, a reversal of direction due to a rolling action of the particles. No eddy currents are induced in any of the conducting materials when powdered. Dr. W. H. Eccles and Dr. Winifred Leyshon showed a neon tube and tuning fork combination for producing electrical oscillations of harmonic frequencies suitable for calibrating wave-meters. The neon tube is connected in parallel with a condenser and in series with a resistance and a battery; it then gives an intermittent luminous discharge and the current can be used to keep a steel tuning-fork in continuous vibration. The current in such a circuit has many high harmonics, and therefore induces an oscillatory current of any chosen harmonic frequency in a neighbouring circuit tuned to that frequency.

Sir Robert Hadfield, Bart., exhibited a number of specimens of alloy steels for special purposes. These included a rotor in 'ERA/ATV' steel used in the construction of exhaust gas turbines. These rotors are driven by the exhaust gases from internal combustion engines; they work continuously at a temperature of from about 800° to 950° C., and run up to the very high testing speed of 53,000 revolutions and working speeds of about 30,000 revolutions per minute. A tuning-fork of high nickel-chromium alloy steel was shown which has constant frequency under varying temperature. For this purpose the metal must have a very low temperature coefficient of the modulus of elasticity.

University and Educational Intelligence.

BIRMINGHAM.—The new buildings for the Department of Oil Engineering and Refining (which have been in use during the past session) were formally opened on June 19 by Sir John Cadman. The department is remarkably well equipped for the training of students in the science and practice of oil technology. There is special provision for experimental research in the production of synthetic liquid fuels and for high-pressure work on the Bergius process. There is a three-year course leading to the ordinary B.Sc. degree and a four-year course for an honours degree in the subject. There is in addition a post-graduate school open to honours graduates of approved universities who have taken engineering or chemistry as principal subjects.

CAMBRIDGE.—The late Mr. W. W. Rouse Ball, Trinity College, who died on April 4 of last year, has left to the University a sum of 25,000*l.* on condition that a professorship or readership of or directly connected with mathematics should be founded, and a further 25,000*l.* for a professorship or readership of some branch or branches of modern English law. He expressed a hope that these professors or readers should include in their lectures historical and philosophical aspects of their subjects. He further left a sum of 10,000*l.* the income from which is to be used for the benefit of, or toward the expense of maintaining, the University library.

In connexion with the celebration of the Bacon tercentenary by Trinity College in October next, it is proposed to confer the honorary degrees of LL.D. on Prof. W. S. Holdsworth, of the University of Oxford, and of Sc.D. on Sir Ernest Rutherford, Trinity College, Cavendish professor of experimental physics and president of the Royal Society.

It is announced from Magdalene College that elections to the Donaldson and Charles Kingsley Bye-Fellowships for the encouragement of research will be made early in July, applications to be made to the Master, Magdalene Lodge, before June 30.

EDINBURGH.—The bicentenary of the institution of the Faculty of Medicine was celebrated on June 10 and 11, when representatives of many famous schools of medicine at home and abroad took part in the commemoration. At the special graduation ceremonial the honorary degree of LL.D. was conferred on the following alumni of Edinburgh: Dr. Andrew Balfour, Director of the London School of Hygiene and Tropical Medicine; Prof. Robert Howden, professor of anatomy, University of Durham; Prof. W. T. A. Jolly, professor of physiology, University of Cape Town; Sir George Newman, Ministry of Health; Prof. Alexander Primrose, professor of clinical medicine, University of Toronto; Sir John Robertson, professor of public health, University of Birmingham; Prof. Ralph Stockman, professor of materia medica, University of Glasgow; Dr. A. Logan Turner, president of the Royal College of Surgeons, Edinburgh; Sir Norman Walker, treasurer of the Royal College of Physicians, Edinburgh; Prof. J. T. Wilson, professor of anatomy, University of Cambridge.

After the graduation Sir George Newman gave an address in which, beginning with the primitive school of medicine at Salerno and later considering the schools in Bologna, Padua and Leyden, he traced the influences which led to the founding of the Edinburgh School. He emphasised the great influence exerted by Boerhaave upon Alexander Monro, who was the founder of the Medical Faculty in Edinburgh, and upon John Rutherford, who introduced clinical teaching in Edinburgh upon the Leyden model. This bedside teaching, with its subsequent developments of clerking and dressing, became one of the characteristic features of the Edinburgh School, which has been copied all over the world. Sir George referred to some of the discoveries associated with the Edinburgh School and remarked that, like all discoveries, they were but stages in the pursuit of truth—they did not begin nor were they completed in Edinburgh, but all of them were substantially advanced there, and of two of them—Simpson's work on the anæsthetic action of chloroform and Lister's antiseptic surgery—it might be said they had entered into the history of mankind.

The reconstructed Surgery Department was formally opened by Sir John Gilmour, Secretary for Scotland. The cost of the reconstruction has been largely met by a generous gift from Mr. T. S. Thomson, brother of the late professor of surgery, Alexis Thomson.

At the meeting of the University Court on June 14, intimation was received from Dr. Harold Robinson, reader in natural philosophy, of his intention to resign, as from the end of the academic year, on his appointment to the chair of physics in the University College of South Wales and Monmouth, Cardiff.

LEEDS.—Mr. B. A. McSwiney has been elected to the chair of physiology, vacant through the death of Prof. W. F. Shanks. Mr. McSwiney is a graduate of the University of Dublin in arts and medicine, and after the War was appointed assistant professor of physiology at Trinity College, Dublin. In 1919 he became lecturer in experimental physiology at Leeds and in the following year at Manchester, a position which he still occupies. He is secretary of the Section of Physiology of the British Association.

Dr. Richard Douglas Passey has been elected to a new chair of experimental pathology and as director of cancer research. Dr. Passey, who is at present lecturer in pathology in the Welsh National School of Medicine, Cardiff, has been engaged in cancer research for some years past, and has published a number of papers on the subject.

Contemporary Birthdays.

June 25, 1859. Prof. Sydney John Hickson, F.R.S.
June 26, 1869. Sir John Flett, K.B.E., F.R.S.
June 27, 1855. Admiral Sir A. Mostyn Field, K.C.B., F.R.S.
June 28, 1851. Sir Alfred Hopkinson, K.C., M.P.
June 29, 1868. Dr. George Ellery Hale, For. Mem. R.S.
June 29, 1844. Sir Francis Fox, M. Inst. C.E.
July 1, 1840. Mr. Edward Clodd.

Prof. HICKSON is a Londoner. He was educated at University College School, and Downing College, Cambridge. In his early career he was some time assistant to Prof. H. N. Moseley, at Oxford. Since 1894 Prof. Hickson has occupied the chair of zoology in the Victoria University, Manchester.

Sir JOHN FLETT, director of H.M. Geological Survey since 1920, was born at Kirkwall, Orkney. He was educated at Watson's College and at the University of Edinburgh, coming there under the guidance, in geological work, of Prof. James Geikie. Before his present official post he was assistant to the director of the Geological Survey of Scotland. In 1902, jointly with the late Dr. Tempest Anderson, he investigated, at the desire of the Royal Society, the volcanic eruption of the Soufrière, in St. Vincent, West Indies, publishing a voluminous report in the *Philosophical Transactions*. Sir John was awarded the Bigsby medal of the Geological Society in 1909.

Sir MOSTYN FIELD, who has carried out highly important marine survey work, was hydrographer to the Admiralty from 1904 until 1909.

Sir ALFRED HOPKINSON, who was born in Manchester, was educated at Owens College in that city, and at Lincoln College, Oxford. Principal of Owens College from 1898 until 1904, he was vice-chancellor of Victoria University of Manchester in 1900–13. Sir Alfred is member of Parliament for the combined English Universities. He is Hon. LL.D. of Glasgow and Aberdeen.

Dr. HALE, distinguished for his researches in solar and stellar spectroscopy, and joint editor of the *Astrophysical Journal*, was born at Chicago. Organiser, and then director of the Yerkes Observatory of the University of Chicago, from 1895 until 1905, he afterwards took up the directorship of Mount Wilson Observatory, Pasadena, California. In 1904 the Royal Astronomical Society awarded its Gold Medal to Dr. Hale for his spectroheliograph method of photographing the solar surface and other astronomical work.

Sir FRANCIS FOX, whose father was Sir Charles Fox, the distinguished engineer of early Victorian times, was born in London. One of the engineers of the Mersey Tunnel, Sir Francis, jointly with his brother, the late Sir Douglas Fox, were constructors of two underground railways. The development of railway schemes in South Africa also engaged his attention. Sir Francis has given unstinted assistance to the authorities of various English cathedrals concerning subsidence problems.

Mr. CLODD was born at Margate and educated at Aldeburgh Grammar School. It means and expresses much to say that he was among those in Huxley's circle of intimates in "the Marlborough Place days." Fifty-four years ago Mr. Clodd published "The Childhood of the World," the precursor of many studies concerning evolutionary foundations.

Societies and Academies.

LONDON.

Royal Society, June 17.—Sir Arthur **Schuster**: A review of Mr. George W. Walker's magnetic survey (1915). Recent magnetic surveys seem to show that the components of magnetic force cannot be completely represented by a potential function, but indicate electric currents cutting the surface of the earth with current densities that are far greater than those obtained from direct measurement. Examination of Mr. Walker's magnetic survey suggests the careful examination of a comparatively small area, rather than an extensive survey of districts so large as those into which the country was divided by Walker in order to test the reality of these currents. If observations are taken at four stations, two of which lie in the meridian and two on a circle of latitude, each station being at a distance of 1·8 miles from the central point, the density of the earth-air current may be determined with a probable error of 0·1 ampere per square kilometre, on the assumption that the difference between the magnetic components at two of the stations can be determined with a probable error of 3γ in a single comparison, and that the observations are repeated 25 times. The mean current density derived from Mr. Walker's survey of eight separate districts is 0·24. Lord **Rayleigh**: The continuous spectrum of mercury vapour in relation to the resonance line 2536·52. The continuous spectrum can be produced without the resonance line, by fluorescent excitation with the aluminium spark, as originally observed by Wood. Under these conditions the continuous spectrum ends at 2535·9 Å.U. and the resonance line appears dark on the continuous background. The band at 2540 also appears sharply reversed on this background. The same continuous spectrum can be obtained in absorption. In this case the measured limit was 2535·5. By lowering the density of the vapour the spectrum with aluminium spark excitation is completely reversed, the resonance line 2536·52 Å.U. and the band 2540 Å.U. now appearing bright on a comparatively dark background. The same effect is obtained by electric discharge in fairly dense vapour, if the exposure is not too heavy.—O. W. **Richardson**: Structure in the secondary hydrogen spectrum (iv.). A more detailed examination of the spectrum has shown that there are a number of other lines which belong to the same system as Fulcher's bands. It is proposed to rearrange these lines so that S_3 to S_{-1} form a Q branch, S the first line of an associated R branch to which there is a corresponding P branch, S_6 and S_{-5} the first two lines of an associated Q' branch, and S_7 the first line of an associated R' branch to which there is a corresponding P branch. This holds throughout the first five of the six red bands. Four similar bands occur in the green and five in the blue; but the branches in those regions which would correspond to the dashed letters have not yet been located with certainty. There is a combination such that $R(m) - P(m+1)$ has the same value for corresponding lines of corresponding bands in the red, the green, and the blue. The quantum structure of the bands can be represented by terms of integral and semi-integral type. The emitter of this band system is the neutral hydrogen molecule H_2 formed and excited by the combination of the ionised hydrogen molecule H_2^+ with an electron.—W. L. **Bragg** and J. **West**: The structure of beryl, $Be_3Al_2Si_6O_{18}$. Beryl has the composition of a metasilicate, the ratio of silicon to oxygen atoms being one to three, though silicon

is surrounded everywhere by four oxygen atoms arranged tetrahedrally, resembling the arrangement in orthosilicates, such as olivine, monticellite, and garnet. The group SiO_4 shares an oxygen atom with each of two neighbouring groups, thus attaining the correct ratio of silicon to oxygen. The hexagonal beryl has a structure like a honeycomb, hexagonal axes passing down empty channels at the centres of cells, the walls of which are formed of densely packed oxygen atoms grouped around beryllium, aluminium, and silicon atoms. No atomic centre is closer than 2·55 Å.U. to a hexagonal axis. The analysis of the structure, which has seven parameters, is carried out by quantitative measurements of intensity of reflexion.—A. P. **Laurie**: On the change of refractive index of linseed oil in the process of drying and its effect on the deterioration of oil paintings. The tendency of the modern oil picture to lower in tone is partly due to the yellowing of the oil film and partly to changes in refractive index. The inquiry took two directions: (1) The examination of certain pigments by grinding them in liquids of various refractive indices, higher than linseed oil, noticing the change of tone and examining under a microscope so as to classify them in order of translucency. (2) In order to test change of refractive index, an oil film was painted out on the glass of a Smith refractometer and observed from time to time. During drying the index rose from 1·480 to 1·490. Since then the film has been observed for some eight or nine months, and the index is now greater than 1·500, a change which produces a visible effect on white-lead and pale yellows. This slow change of refractive index no doubt continues for many years. Light is thus thrown on the method of painting in oil by the fifteenth-century painter, who laid down a scheme in black-and-white or brilliant colour in a medium of low refractive index, and glazed over this with thin oil paint, thus securing that as the pigments became more translucent more light would be reflected from the painting below, thereby keeping up tone and brilliancy in his pictures.

Royal Microscopical Society, May 19.—James C. **Mottram**: A note on the effects of β-radiation on *Colpidium colpoda* as seen in stained specimens. In view of the presence of macro- and micro-nuclei in Infusoria, and of the different functions which these appear to control, the macro-nucleus controlling asexual cell division, and the micro-nucleus syngamy and sexual division, exposures to radium were made to discover whether the nuclei would exhibit any differences in sensitiveness to β-radiation. No histological changes were observed in the micro-nucleus. The macro-nucleus, however, was affected by relatively short exposures. Stained specimens also showed another early effect. In this species, rod-shaped mitochondria lying close to the surface are arranged in lines running longitudinally; after irradiation, the microchondria are distributed at random, and instead of being rod-shaped, and of approximately the same size, they are seen to be irregular granules of various sizes.—Miss Joyce F. **Raves**: Mitosis in *Anacylus Pyrethrum*. The chromosome number is 18, a number in accordance with the chromosome number series of the Anthemideæ, the cardinal number of this series being 9. In the prophase stages of nuclear division there is observed a parallel banding of the spireme, similar to that seen in telophase, and the following division always occurs at right angles to the direction of this banding. There is some evidence that when one daughter nucleus is to divide in a plane at right angles to that of the former division, it revolves through a right angle while in the telophase condition, before it is completely rounded off as a new nucleus, so that the next division may also be at right angles to the direction of the spireme banding. This suggests that the nuclear material never changes its position during the resting stage.

EDINBURGH.

Royal Society, June 7.—F. H. **Edgeworth**: The development of the cranial muscles of Protopterus and Lepidosiren. The main facts in the development of the mandibular skeleton as described by Agar are confirmed, but a separate ascending process of the pterygoquadrate, with typical relations to the first division of the fifth nerve, is described. The cranial muscles of the Dipneumona are very similar to those of Ceratodus. They are more primitive in that external gill-muscles are present. In other respects they are similar to, or show slight modifications of, those present in Ceratodus.—G. W. **Tyrrell** and M. A. **Peacock**: The petrology of Iceland; Part I., The basic tuffs, by M. A. **Peacock**. The Pleistocene basic tuffs of Iceland are either sideromelan-tuffs or palagonite-tuffs. Sideromelan is basaltic glass which is produced in the fragmented condition by subglacial extrusions; the drastic chilling thus suffered by the extruded liquid renders the product translucent, due to the inhibition of ore-separation. Palagoni is the hydro-gel of sideromelan. Palagonitisation results from the action on sideromelan either of hot springs, or of cold sea-water.—E. **Prawochenski** and B. **Kaczkowski**: Observations on the fragment of a horse skull from interglacial deposits near Pulawy, Poland. The Vistula horse belonged to the group of small European horses, probably to the Tarpans (Gmelin), or to the ponies of the "plateau type" (Ewart)—the group which included Celtic and Arab ponies, characterised by slender limbs, and only two of the eight callosities found in horses of the forest type. The Veglia (Adriatic) pony, though hitherto regarded as descended from the Tarpan, really belonged to a forest type. The wild horse (*E. przewalskii*) of Mongolia belonged to "the heaviest type of the primitive equidæ"—an interesting conclusion, because some authors who studied the skulls of modern heavy breeds, came to the conclusion that in all probability the Clydesdales and Shires included steppe horses among their ancestors.—J. **Cossar Ewart**: The coat of the Lapland wolf. In some mammals the coat consists almost entirely of simple fibres made up of a solid cortex and of a cuticle, *i.e.* of wool fibres; in others the coat consists of fibres containing pith cells separated by spaces, thus forming a discontinuous pith or medulla, *i.e.* fur fibres; in other mammals there is a continuous medulla, and these are known as true hair fibres. In the wolf the coat consists of bundles of fur fibres, all the fibres of each bundle occupying a single pit or follicle. In the Lapland wolf there are long coarse fibres, forming an outer coat, and fine and intermediate fibres forming an inner coat. The inner portion of the long fibres has the structure of fur, the outer portion has the structure of true hair, the middle portion differs but little from fur proximally but resembles hair distally. The short fine fibres of the inner coat are typical fur fibres. The inner portion of the intermediate fibres has a discontinuous medulla, the outer portion a continuous medulla as in the long outer coat fibres. Instead of all the fibres of a bundle occupying one pit or follicle, the root of each fibre is lodged in a separate follicle, there is a large follicle for the long outer coat fibre, and underlying the large follicle fifteen or more slender follicles for the fine and intermediate fibres of the inner coat. In some dogs there

are, in addition to wool fibres and fur fibres, numerous fibres the inner half of which has the structure of wool, the outer of true hair. Sometimes the inner third resembles wool, the middle third fur, and the outer third true hair.—Y. **Tamura** and F. A. E. **Crew**: The effect of uncomplicated vasectomy and epididymo-differentectomy in the mouse. Definite degeneration of the germinal epithelium is induced by both procedures, but its onset and progress are much more rapid after epididymo-deferentectomy.

PARIS.

Academy of Sciences, May 17.—André **Blondel**: The initial conditions of the disturbed régime of currents.—R. de **Forcrand**: The thermochemistry of thallium alcoholates and salts.—M. **Biernacki**: Some theorems of algebra.—Leonida **Tonelli**: The quadrature of surfaces.—Gaston **Julia**: The polynomials of Tchebichef.—W. S. **Fédoroff**: The representation of analytical domains and functions.—Stefan **Kempisty**: The differentials of the ensemble function.—J. L. **Routin**: A new synchronous induction motor starting automatically, and capable of being worked by Hertzian waves, with reference to the problems of teleindication and television.—C. G. **Bedreag**: The arc spectrum of copper.—F. **Darmois**: The salt effect and rotatory power.—A. **Zimmern** and Maxime **Coutin**: The production of polarising surfaces by the deposit of herepathite upon vertical plates.—Pierre **Auger**: The yield of fluorescence in the domain of the X-rays.—René **Dubrisay**: Researches on adsorption.—P. **Brun**: The properties of ternary liquid mixtures. Studies of the physical properties of mixtures of water and ethyl alcohol with a third alcohol. For the third alcohol the three cases studied were propanol, entirely miscible, isobutanol, fairly miscible, and isoamyl alcohol, slightly miscible. Curves are given for the case of isoamyl alcohol.—B. **Bogitch**: Concerning the granulation of scoria and of metals. The usual method of pouring into water from a height occasionally gives rise to explosions. If compressed air is forced into the bottom of the water vessel, below the point of fall of the liquid jet, the risk of explosion is removed. The dimensions of the water vessel can be reduced, and a smaller height of fall for the liquid jet is possible.—N. **Bezssonoff**: The rapid preparation of mono-molybdophosphotungstic acid, a reagent for polyphenols and vitamins. The purification is based on the insolubility of the complex acid in 30 per cent. sulphuric acid.—J. **Bougault**: An example of a hydrated ketone ether oxide. A correction of some results given in earlier communications.—Mme. Pauline **Ramart**: The alkylation of the nitriles of the fatty series. The preparation of di- and trialkylacetonitriles. Aliphatic nitriles, treated with sodium amide, give sodium derivatives, and these when treated with alkyl halogenides give the α-alkylnitriles.—R. **Marquis**: The oxidation of acenaphthene. Acenaphthene can be directly oxidised to acenaphthenol by lead dioxide in acetic acid solution.—J. H. **Hoffet**: The age of the limestones of Creüe.—P. L. **Mercanton**: The magnetisation of Australian volcanic rocks. From the magnetisation of the rocks examined it is concluded that the inclination of the earth's magnetic field in Australia was at one time in the opposite sense to that at the present day.—Lucien **Mayet**: A summary anthropological examination of the fossil men of Denise, near Le Puy-en-Velay. These remains represent the oldest human documents discovered in France, coming between *Eoanthropus Dawsoni* and *Homo neanderthalensis*.—F. **Roman**: The discovery of a fauna of mammals of the Pontian stage at Libros (Province of Teruel, Spain).—A. **Demolon**: The absorption and mobilisation of the potassium ion in clay colloids.—Edmond **Sergent** and H. **Rougebief**: The antagonism between drosophils and moulds.—Claude **Fromageot**: The oxidation-reduction potential of reversible oxidising systems, and the oxidation of organic molecules by these systems.—H. **Barthélemy**: The action of glycogen and of white of egg of the fowl on the spermatozoids of *Rana fusca*.—Robert **Weill**: A special category of nematocysts common to hydra, gymnoblastids and siphonophores.—Ch. **Porcher**: The action of heat on the complex caseinate of lime plus calcium phosphate. The greater sensibility of the phosphatic particles.—Georges **Bourguignon**, Max **Courland** and Mlle. Renée **Déjean**: Variations of chronaxy in lesions of the retina and of the retro-bulbar segment of the optic nerve.

ROME.

Royal National Academy of the Lincei, April 11.—Leonida **Tonelli**: Quadrature of surfaces.—G. A. **Crocco**: The possibility of super-aviation. Although it may be possible by the ordinary means of aviation to attain sub-acoustic velocities, hyper-acoustic velocities would require a new moto-propulsive method such as that of the reaction propulsor. In such a case, if the weight remains constant, the quantity of fuel necessary for a certain horizontal, uniform flight is inversely proportional to the product of the velocity of flight and the velocity of egress of the propulsive jet.—A. **Angeli**: Supposed priority with regard to the conductivity of unsaturated chains.—Antonio **Colucci**: An assumed property of symmetrical determinants of the sixth order.—Luigi **Fantappiè**: Determination of groups with a parameter of linear functionals.—Guérard des **Lauriers**: Spaces geodetically applicable beyond Dini's case.—Gaetano **Scorza**: Apiristic resolution of binomial congruences and Lagrange's interpolation formula.—E. **Bompiani**: The geometry of surfaces considered in ruled space.—Mauro **Picone**: The duration of small oscillations of the most general curvilinear pendulum.—Vasco **Ronchi**: Zonal gratings as interferometer objectives.—Luigi **Rolla** and Giorgio **Piccardi**: Ionisation potentials of certain elements of the rare earth group.—Giorgio **Piccardi**: The affinity of the iodine atom for the electron.—Giulia **Lugaro**: Bismuthinite from St. Agnes (Cornwall).—F. Stella **Starrabba**: Two different diagrams for the eruptivity of Japanese volcanoes.

VIENNA.

Academy of Sciences, May 6.—L. **Moser** and K. **Schmidt**: Determination and separation of rare metals from other metals (vii). Determination of tungsten compounds and of metallic tungsten by distillation in a current of carbon tetrachloride vapour. The addition of chlorine to the tetrachloride checks dissociation and reduces the concentration of nascent chlorine. By the addition of air, carbon is oxidised and more nascent chlorine liberated. Tungsten, tungstates, tungsten minerals were completely decomposed and tungsten chlorides obtained in the distillate, and either precipitated with benzidin or evaporated to dryness with nitric acid. Since iron is also volatilised, a method was worked out for heating an iron-tungsten mixture with ammonium bromide at 300°, which volatilised iron only. Tungsten wire has proved very resistant to chemical attack. It was oxidised in an oven by oxygen to WO_3, and even this oxide was resistant in carbon tetrachloride. The WO_3 was reduced by hydrogen to amorphous tungsten, which could easily be volatilised in carbon tetrachloride. Various oxides remain behind. This quick

method of analysing tungsten wire is likely to be useful in the incandescent lamp industry.—P. T. **Schwarz**: Influence of thermometer exposure on the observed results of temperature in Kremsmünster.—H. V. **Ficker**: Direction of wind and clouds in Teneriffe.—F. **Kerner-Marilaun**: Harmonic analysis of the temperature in the South Atlantic current circuit. Diagrams were drawn on the Seewarte-Atlas dividing the main line of the current into 24 equal portions. The points of this division were transferred to the isotherm chart. Diagrams were drawn for the yearly warmth transition at each point, and hence equations were obtained.—F. **Werner**: New or little-known snakes in the State Museum of Natural History at Vienna.—L. **Hajek** and F. **Scheminzky**: Low-frequency amplifiers in phonograph construction.—G. **Luft**: Distribution of saponins and tannins in plants.—P. **Fantl** and M. **Kabos**: Zinc-dust distillation of cholesterin.

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FINSBURY TECHNICAL COLLEGE OLD STUDENTS' ASSOCIATION (at Finsbury Technical College), at 8.—C. A. Darling: The Rise of Atomic Physics (Silvanus Thompson Memorial Lecture).

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SATURDAY, JULY 3.

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JULY 2 AND 3.

INTERNATIONAL FEDERATION OF EUGENICS (at Paris).

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